Salmon and Steelhead
Habitat Limiting Factors in WRIA 29

Prepared by:
Washington Conservation Commission

July 1999

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ABSTRACT

Water Resource Inventory Area (WRIA) 29 is a historically important source for production of anadromous fish in the Lower Columbia basin. Two large stream systems, the Wind and White Salmon Rivers provided abundant habitat for returning fish. Small stocks in several smaller tributaries of the Columbia further supplemented fish populations in the WRIA.

Hydroelectric development on the White Salmon River, construction of Bonneville Dam with its associated pool, logging in the Gifford Pinchot National Forest, poorly designed and installed culverts, especially along State Highway 14, and other factors have had a seriously detrimental effect on the aquatic resources of the WRIA. Only the Wind River remains as a major fish producing stream system in the WRIA, and its productivity has steadily decreased over the years.

Stream cleanouts, past timber harvest (especially in riparian areas), the presence of a dam with a poorly designed fish ladder, a lack of large woody debris, mass bedload movement, loss of floodplain capacity, and increased siltation are a few of the impacts evident in the Wind River basin. By 1992, summer steelhead stocks which may have at one time numbered in excess of 5000 fish had fallen to an annual average of 222.

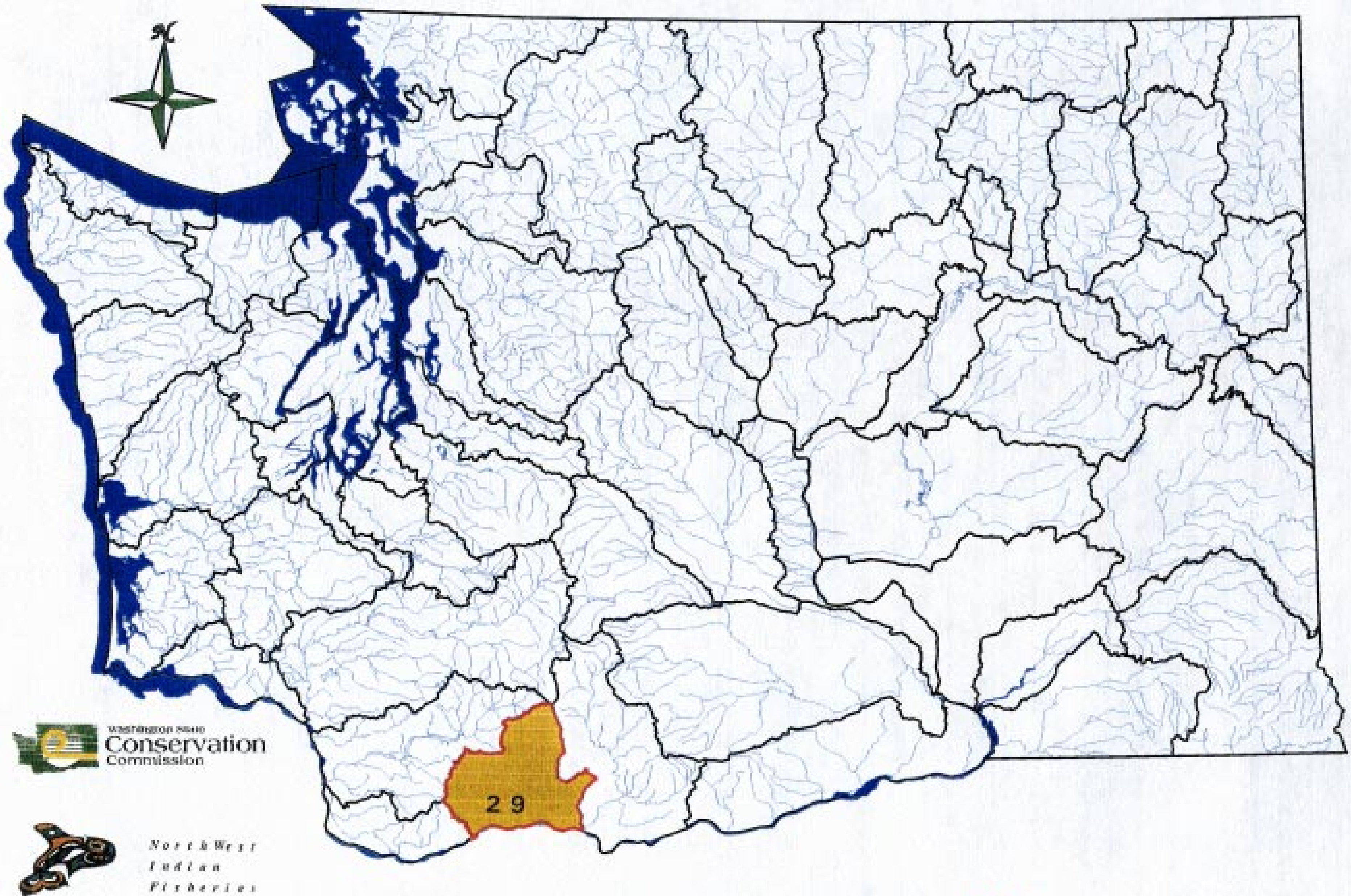
But the picture is not entirely bleak for the WRIA. On the Wind River, the U. S. Forest Service's Northwest Forest Plan, coupled with an active watershed counsel is turning the corner on restoring the damaged watershed. On the White Salmon River, negotiations are underway to remove Condit Dam, a hydroelectric facility that has blocked fish passage above river mile 3.3 since 1919.

This report attempts to list and prioritize those limiting factors that are the most severe and in need of correction in the WRIA. By so doing, limited restoration funds may be targeted at the most critical factors, and in time, restoring a once productive watershed to its former levels.

PURPOSE

The purpose of this report is to provide a habitat impediment inventory for Water Resource Inventory Area (WRIA) 29 in a form and manner that assists local citizen groups in developing functional habitat protection and restoration projects.

WASHINGTON STATE WRIAs & MAJOR RIVERS



Location of WRIA 29 Outlined in Red

WHAT IS A LIMITING FACTOR?

The concept of habitat "limiting factors" has been defined differently in various forums. A common definition of limiting (habitat) factors links the concepts of carrying capacity, life stage, and available habitat. As an example of this definition, in their *Final Report: Development and Evaluation of Techniques to Rehabilitate Oregon's Wild Salmonids*, the Oregon Department of Fish and Wildlife defines carrying capacity (in this case for coho) as "the number of wild smolts produced, as determined by freshwater life stage most restricted by the limiting habitat." The "limiting habitat" is then defined as "that habitat required to support a particular life stage of a given species…but is in the shortest supply relative to habitats required to support other life stages. In this context, the limiting habitat can be considered a limiting factor."

When looking at individual life stages then, the limiting factor for a stream would be that condition which creates the "bottleneck" in the system. For example, a system may suffer from two distinct problems: a level of excessive fines in the spawning gravels and excessively high temperatures during the late summer. In this case, the lack of cool water refugia may be the factor limiting the number of smolts leaving the system. A restoration project to clean spawning gravel and correct the source of the sediment input may produce clean spawning gravel and therefor more fry, but excessive temperatures in the late summer will wipe out those gains. In this example, using this definition, excessive temperature is the limiting factor. Once the temperature problem is addressed, the condition of the spawning beds may then become the limiting factor.

This example is obviously overly simplified, but serves to demonstrate the concept. In reality, isolating a single, discrete condition as the primary focus for limiting fish production may be difficult at best. Conditions often interact and overlap. High temperatures may result from and interact with a lack of deep pools, loss of floodplain connectivity, and a number of other factors. Separating these conditions into their component parts and assigning values to them is a difficult but important task. Given our current realities of limited funding and resources, it is particularly important that the scarce funds available for restoration are targeted at the most limiting factors.

Engrossed Substitute House Bill 2496 (the legislation authorizing this report), passed by the 1998 legislature, takes a broader approach to defining limiting factors. The bill defines limiting factors as "…conditions that limit the ability of habitat to fully sustain populations of salmon. These factors are primarily fish passage barriers and degraded estuarine areas, riparian corridors, stream channels, and wetlands." Under this definition, all habitat conditions that limit salmon and steelhead are considered limiting factors. In the previous example, both the excessive fines and the excessive temperatures would be limiting factors. Based on the legislation's definition, for the purpose of this report, *a limiting factor is any condition of decreased habitat health that has a direct, adverse impact on anadromous fish during one or more life stages*.

The conditions that we call limiting factors are often caused by some related factor. For example, low flow may be caused by upstream water withdrawls. Occasionally, a limiting factor may be linked by a chain of conditions to a problem somewhat removed from the specific Limiting Factor. The previous example of an over-abundance of fine sediment in a spawning bed may well apply here. An over-abundance of fine sediment in a spawning bed may be caused by a failing bank upstream in the system, which in turn may be caused by the loss of riparian function through any number of various management activities.

For the purposes of this report, these underlying causes are called “site problems.” A site problem is a local, underlying condition that ultimately contributes to one or more limiting factors. In some cases, the site problem may be the immediate and direct cause of the limiting factor. A perched culvert would be a passage barrier. In other cases, as described in the previous paragraph, the site problem may be somewhat removed both in location and in cause/effect relationship from the actual limiting factor.

An individual site problem may contribute to more than one limiting factor. A loss of riparian function may contribute to increased downstream temperatures, a lack of pools due to the lack of large woody debris, increased sediment transport, and other negative impacts. Conversely, one limiting factor may have several site problems contributing to it. A temperature exceedence may be caused by a number of separate riparian impacts upstream, and one or more impoundments. These contributing site problems may be of varying significance to the limiting factor in question.

Because it is the intent of this report to address the causes of the limiting factors, our focus is on the site problems which ultimately lead to degraded habitat. Performing a short term fix on a chronic problem is short-sighted and in many cases a waste of money and resources. Cleaning gravels is of little long term benefit if the source of the fine sediment input is not corrected. It is the intent of this report that project sponsors will choose restoration projects that address long term problem causes (site problems) as the primary focus of restoration efforts. With long term problem resolution underway (e.g., restoring a riparian zone to stabilize a bank), short term limiting factor correction (such as gravel cleaning) may be entirely appropriate. Because of the necessity to target scarce restoration resources on those factors that have the greatest impact on fish production, a ranked list of site problems is included.

As a first effort, we have attempted to gather as much data on these watersheds as possible in a limited amount time. There is undoubtedly much data and information that has been overlooked or otherwise missed. This project is cyclical in nature. Contributions to “fill in the holes” and suggestions to correct mistakes are strongly desired.

THE ROLE OF HABITAT IN HEALTHY POPULATIONS OF NATURALLY SPAWNING SALMON

During the last 10,000 years, Washington state anadromous salmonid populations have evolved in their specific habitats (Miller, 1965). Water chemistry, flow, and the physical stream components unique to each stream have helped shaped the characteristics of each salmon population. These unique physical attributes have resulted in a wide variety of distinct salmon stocks for each salmon species throughout the State. Within a given species, stocks are population units that do not extensively interbreed because returning adults rely on a stream's unique chemical and physical characteristics to guide them to their natal grounds to spawn. This maintains the separation of stocks during reproduction, thus preserving the distinctiveness of each stock.

The dependence of a stock on its natal stream continues throughout the salmon's life cycle. Adults spawn in areas near their own origin because survival favors those that do. The timing of juveniles leaving the river and entering the estuary is tied to high natural river flows. It has been theorized that the faster speed during out-migration reduces predation on the young salmon and perhaps is coincident to favorable feeding conditions in the estuary (Wetherall, 1971). These are a few examples that illustrate how a salmon stock and its environment are intertwined throughout the entire life cycle.

Salmon habitat includes the physical, chemical and biological components of the environment that support salmon. Within freshwater and estuarine environments, these components include water quality, water quantity or flows, stream and river physical features, riparian zones, upland terrestrial conditions, and ecosystem interactions as they pertain to habitat. However, these components closely intertwine. Low stream flows can alter water quality by increasing temperatures and decreasing the amount of available dissolved oxygen, while concentrating toxic materials. Water quality can impact stream conditions through heavy sediment loads, which result in a corresponding increase in channel instability and decrease in spawning success. The riparian zone interacts with the stream environment, providing nutrients and a food web base, woody debris for habitat and flow control (stream features), filtering runoff prior to surface water entry (water quality), and providing shade to aid in water temperature control.

Salmon habitat includes clean, cool, well-oxygenated water flowing at a normal (natural) rate for all stages of freshwater life. In addition, salmon survival depends upon specific habitat needs for egg incubation, juvenile rearing, migration of juveniles to saltwater, estuary rearing, ocean rearing, adult migration to spawning areas, and spawning. These specific needs can vary by species and even by stock.

When adults return to spawn, they not only need adequate flows and water quality, but also unimpeded passage to their natal grounds. They need deep pools with vegetative cover and instream structures such as root wads for resting and shelter from predators. Successful spawning and incubation depend on sufficient gravel of the right size for that particular population, in addition to the constant need of adequate flows and water quality, all in unison at the necessary location.

After spawning, the eggs need stable gravel that is not choked with sediment. River channel stability is vital at this life history stage. Floods have their greatest impact to salmon populations during incubation, and flood impacts are worsened by human activities. In a natural river system, the upland areas are forested, and the trees and their roots store precipitation, which slows the rate of release of storm water into the stream. The natural, healthy river is sinuous and contains large pieces of wood contributed by an intact, mature riparian zone. Both slow the speed of water downstream. Natural systems have floodplains that are connected directly to the river at many points, allowing wetlands to store flood water and later discharge this storage back to the river during lower flows. In a healthy river, erosion or sediment input is great enough to provide new gravel for spawning and incubation, but does not overwhelm the system, raising the riverbed and increasing channel instability. A stable incubation environment is essential for salmon. Such an environment is the result of the complex interaction of nearly all habitat components contained within the river ecosystem.

Once the fry emerge from the gravel nests, certain species such as chum, pink, and some chinook salmon quickly migrate downstream to the estuary. Other species, such as coho, steelhead, bulltrout, and chinook, will search for suitable rearing habitat within the side sloughs and channels, tributaries, and spring-fed "seep" areas, as well as the outer edges of the stream. These quiet-water side margin and off channel slough areas are vital for early juvenile habitat. The presence of woody debris and overhead cover aid in food and nutrient inputs as well as provide protection from predators. For most of these species, juveniles use this type of habitat in the spring.

As growth continues, the juvenile salmon (parr) move away from the quiet shallow areas to deeper, faster areas of the stream. These include coho, steelhead, bulltrout, and certain chinook. For some of these species, this movement is coincident with the summer low flows. Low flows constrain salmon production for stocks that rear within the stream. In non-glacial streams, summer flows are maintained by precipitation, connectivity to wetland discharges, and groundwater inputs. Reductions in these inputs will reduce that amount of habitat; hence the number of salmon dependent on adequate summer flows.

In the fall, juvenile salmon that remain in freshwater begin to move out of the mainstems, and again, off-channel habitat becomes important. During the winter, coho, steelhead, bulltrout, and remaining chinook parr require habitat to sustain their growth and protect them from predators and winter flows. Wetlands, stream habitat protected from the effects of high flows, and pools with overhead are important habitat components during this time.

Except for bulltrout and resident steelhead, juvenile parr convert to smolts as they migrate downstream towards the estuary. Again, flows are critical, and food and shelter are necessary. The natural flow regime in each river is unique, and has shaped the population's characteristics through adaptation over the last 10,000 years. Because of the close inter-relationship between a salmon stock and its stream, survival of the stock depends heavily on natural flow patterns.

The estuary provides an ideal area for rapid growth, and some salmon species are heavily dependent on estuaries, particularly chinook, chum, and to a lesser extent, pink salmon. Estuaries contain new food sources to support the rapid growth of salmon smolts, but adequate natural habitat must exist to support the detritus-based food web, such as eelgrass beds, mudflats, and salt marshes. Also, the processes that contribute nutrients and woody debris to these environments must be maintained to provide cover from predators and to sustain the food web. Common disruptions to these habitats include dikes, bulkheads, dredging and filling activities, pollution, and alteration of downstream components such as lack of woody debris and sediment transport.

All salmonid species depend on this web of adequate flow and water quality, spawning riffles and pools, a functional riparian zone, a functional estuary, and upland conditions that favor stability. Some of these specific needs vary by species, such as preferred spawning areas and gravel. Although some overlap occurs, different salmon species within a river are often staggered in their use of a particular type of habitat. Some are staggered in time, and others are separated by distance.

Chinook salmon have three major run types in Washington State. Spring chinook are in their natal rivers throughout the calendar year. Adults begin river entry as early as February in the Chehalis, but in Puget Sound, entry doesn't begin until April or May. Spring chinook spawn from July through September and typically spawn in the headwater areas where higher gradient habitat exists. Incubation continues throughout the autumn and winter and generally requires more time for the eggs to develop into fry because of the colder temperatures in the headwater areas. Fry begin to leave the gravel nests in February through early March. After a short rearing period in the shallow side margins and sloughs, all Puget Sound and coastal spring chinook stocks have juveniles that begin to leave the rivers to the estuary throughout spring and into summer (August). Within a given Puget Sound stock, it is not uncommon for other chinook juveniles to remain in the river for another year before leaving as yearlings, so that a wide variety of outmigration strategies are used by these stocks. The juveniles of spring chinook salmon stocks in the Columbia Basin exhibit some distinct juvenile life history characteristics. Generally, these stocks remain in the basin for a full year. However, some stocks migrate downstream from their natal tributaries in the fall and early winter into larger rivers and Columbia River where they are believed to over winter prior to outmigration the next spring as yearling smolts.

Adult summer chinook begin river entry as early as June in the Columbia, and generally spawn in September and/or October. Fall chinook stocks range in spawn timing from late September through December. All Washington summer and fall chinook stocks have juveniles that incubate in the gravel until January through early March, and outmigration downstream to the estuaries occurs over a broad time period (January through August). Within a few of these stocks, is a component of juveniles that remain in freshwater for a full year after emerging from the gravel nests.

While some emerging chinook salmon fry outmigrate quickly, most inhabit the shallow side margins and side sloughs for up to two months. Then, some gradually move into the faster water areas of the stream to rear, while others outmigrate to the estuary. Most summer and fall chinook outmigrate within their first year of life, but a few stocks (Snohomish summer chinook, Snohomish fall chinook, upper Columbia summer chinook) have juveniles that remain in the river for an additional year, similar to many spring chinook (Marshall et al, 1995). However, those in the upper Columbia, have scale patterns that suggest that they rear in a reservoir-like environment (mainstem Columbia upstream from a dam) rather than in their natal streams and it is unknown whether this is a result of dam influence or whether it is a natural pattern.

The onset of coho salmon spawning is tied to the first significant fall freshet. They typically enter freshwater from September to early December, but has been observed as early as late July and as late as mid-January (WDF et al, 1993). They often mill near the river mouths or in lower river pools until freshets occur. Spawning usually occurs between November and early February, but is sometimes as early as mid-October and can extend into March. Spawning typically occurs in tributaries and sedimentation in these tributaries can be a problem, suffocating eggs. As chinook salmon fry exit the shallow low-velocity rearing areas, coho fry enter the same areas for the same purpose. As they grow, juveniles move into faster water and disperse into tributaries and areas which adults cannot access (Neave 1949). Pool habitat is important not only for returning adults, but for all stages of juvenile development. Preferred pool habitat includes deep pools with riparian cover and woody debris.

All coho juveniles remain in the river for a full year after leaving the gravel nests, but during the summer after early rearing, low flows can lead to problems such as a physical reduction of available habitat, increased stranding, decreased dissolved oxygen, increased temperature, and increased predation. Juvenile coho are highly territorial and can occupy the same area for a long period of time (Hoar, 1958). The abundance of coho can be limited by the number of suitable territories available (Larkin, 1977). Streams with more structure (logs, undercut banks, etc.) support more coho (Scrivener and Andersen, 1982), not only because they provide more territories (useable habitat), but they also provide more food and cover. There is a positive correlation between their primary diet of insect material in stomachs and the extent the stream was overgrown with vegetation (Chapman, 1965). In addition, the leaf litter in the fall contributes to aquatic insect production (Meehan et al, 1977).

In the autumn as the temperatures decrease, juvenile coho move into deeper pools, hide under logs, tree roots, and undercut banks (Hartman, 1965). The fall freshets redistribute them (Scarlett and Cederholm, 1984), and over-wintering generally occurs in available side channels, spring-fed ponds, and other off-channel sites to avoid winter floods (Peterson, 1980). The lack of side channels and small tributaries may limit coho survival (Cederholm and Scarlett, 1981). As coho juveniles grow into yearlings, they become more predatory on other salmonids. Coho begin to leave the river a full year after emerging from their gravel nests with the peak outmigration occurring in early May.

Coho use estuaries primarily for interim food while they adjust physiologically to saltwater.

Steelhead have the most complex life history patterns of any Pacific salmonid species (Shapovalov and Taft, 1954). In Washington, there are two major run types, winter and summer steelhead. Winter steelhead adults begin river entry in a mature reproductive state in December and generally spawn from February through May. Summer steelhead adults enter the river from about May through October with spawning from about February through April. They enter the river in an immature state and require several months to mature (Burgner et al, 1992). Summer steelhead usually spawn farther upstream than winter stocks (Withler, 1966) and dominate inland areas such as the Columbia Basin. However, the coastal streams support more winter steelhead populations.

Juvenile steelhead can either migrate to sea or remain in freshwater as rainbow or redband trout. In Washington, those that are anadromous usually spend 1-3 years in freshwater, with the greatest proportion spending two years (Busby et al, 1996). Because of this, steelhead rely heavily on the freshwater habitat and are present in streams all year long.

Bulltrout/Dolly Varden stocks are also very dependent on the freshwater environment, where they reproduce only in clean, cold, relatively pristine streams. Within a given stock, some adults remain in freshwater their entire lives, while others migrate to the estuary where they stay during the spring and summer. They then return upstream to spawn in late summer. Those that remain in freshwater either stay near their spawning areas as residents, or migrate upstsream throughout the winter, spring, and early summer, residing in pools. They return to spawning areas in late summer. In some stocks juveniles migrate downstream in spring, overwinter in the lower river, then enter the estuary and Puget Sound the following late winter to early spring (WDFW, 1998). Because these life history types have different habitat characteristics and requirements, bulltrout are generally recognized as a sensitive species by natural resource management agencies. Reductions in their abundance or distribution are inferred to represent strong evidence of habitat degradation.

In addition to the above-described relationships between various salmon species and their habitats, there are also interactions between the species that have evolved over the last 10,000 years such that the survival of one species might be enhanced or impacted by the presence of another. Pink and chum salmon fry are frequently food items of coho smolts, Dolly Varden charr, and steelhead (Hunter, 1959). Chum fry have decreased feeding and growth rates when pink salmon juveniles are abundant (Ivankov and Andreyev, 1971), probably the result of occupying the same habitat at the same time (competition). These are just a few examples. Carcasses of salmon which died subsequent to spawning provide many nutrients that begins the food web on which future generations depend.

Most streams in Washington are home to several salmonid species, which together, rely upon freshwater and estuary habitat the entire calendar year. As the habitat and salmon review indicated, there are complex interactions between different habitat components, between salmon and their habitat, and between different species of salmon. For just as habitat dictates salmon types and production, salmon contribute to habitat and to other species.

SALMON HABITAT IN WRIA 29

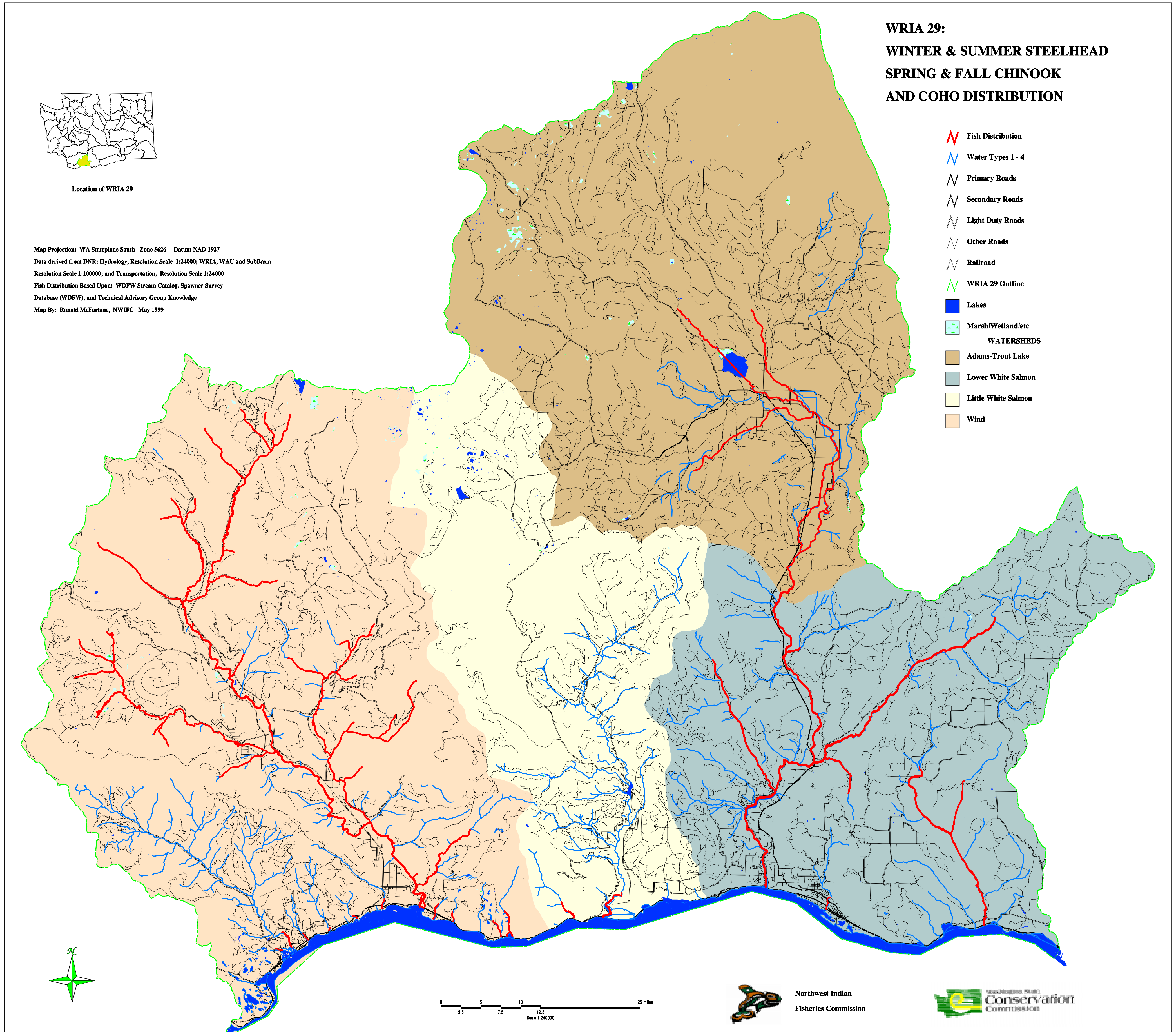
Water Resource Inventory Area (WRIA) 29 includes a number of watersheds with varying degrees of fish use. The Wind River is the principle stream with anadromous usage. Most other streams in the WRIA have limited natural habitat due in large measure to the geography of the Columbia River Gorge. Most streams travel only a short distance up from the Columbia prior to ascending the steep walls of the gorge. Undoubtedly, the pool of Bonneville Dam (immediately downstream of the WRIA) has inundated much of the salmon and steelhead habitat originally present low in these streams. Two exceptions to this rule are the White Salmon River and Major Creek. Both have gradient suitable for anadromous fish throughout much of their length. However, Condit Dam blocks all access to the upper White Salmon River at river mile 3.3. While Major Creek remains accessible to anadromous fish, their presence has not been confirmed through most of its length, and are only presumed to be present. Other streams in the WRIA include Foster Creek, Rock Creek, Kanaka Creek, Nelson Creek, Carson Creek, Collins Creek, Grant Lake Creek, Dog Creek, the Little White Salmon River, and Jewett Creek. The entire WRIA is immediately upstream of Bonneville Dam, and all streams flow into the Bonneville Pool.

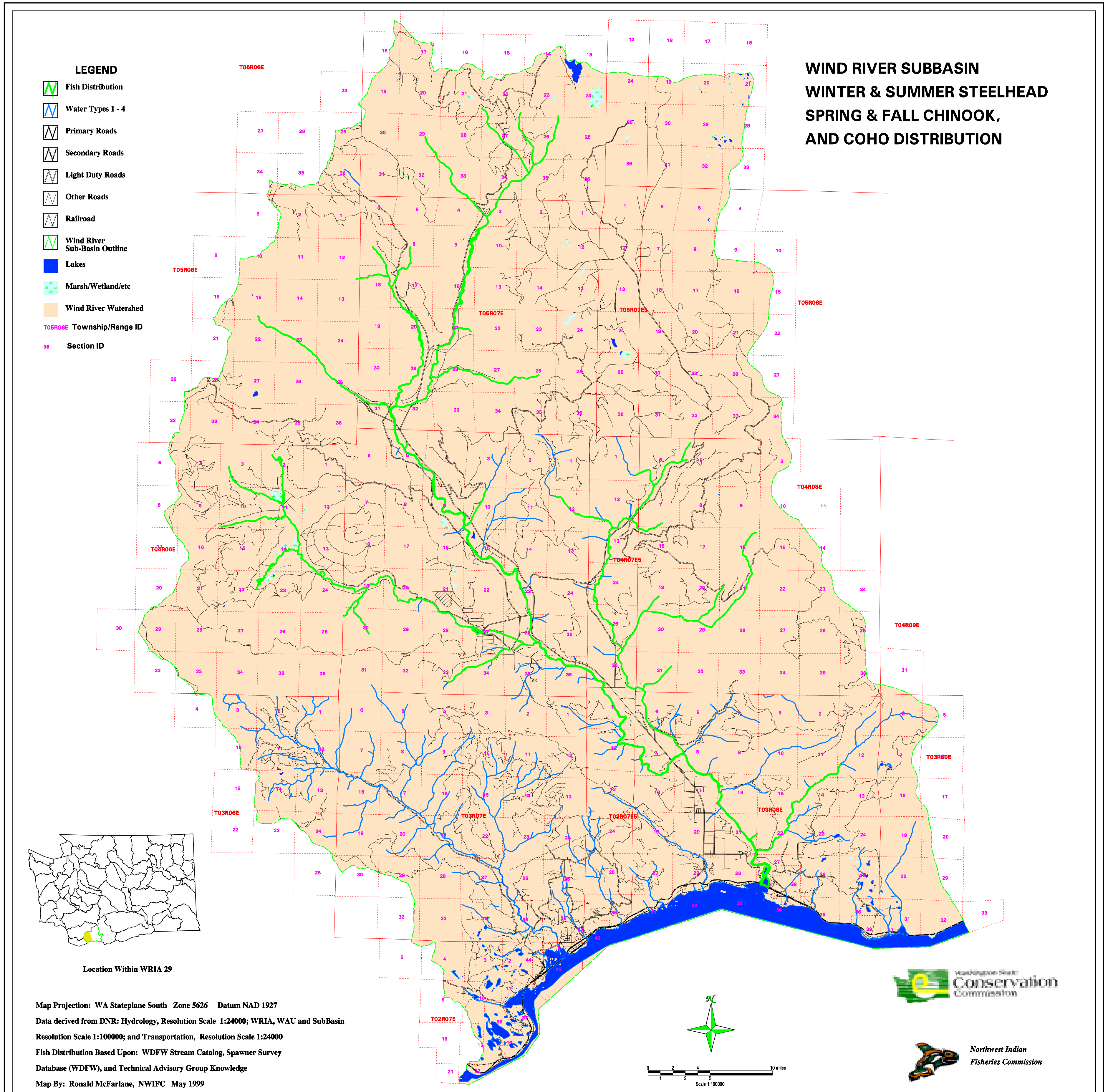
WRIA 29 lies in the Cascade Mountains of southwestern Washington State. The WRIA lies astride of the Cascade crest. Its weather patterns are dominated by the clash of the moderate, moist Pacific air mass to the west and the dryer continental air mass to the east. The WRIA is marked by cool, wet winters, and warm, dry summers. Much of the WRIA's precipitation falls in the winter months as snow. With the exception of the White Salmon River with its headwaters on the flanks of Mt. Adams, the streams of the WRIA have no glaciers or permanent ice fields to feed them through the summer. The streams depend on groundwater provided by snowmelt and spring rains to provide cool water for summer flow.

Precipitation is more plentiful and temperatures more moderate in the western end of the WRIA, near Stevenson, where the moist Pacific air mass dominates. The climate becomes drier with greater seasonal temperature variations as one travels to the eastern end of the WRIA near Bingen, Washington, where the continental air mass is more dominant.

Most of the western two thirds of the WRIA lie within the Gifford Pinchot national Forest. The Columbia River Gorge National Scenic Area stretches across the WRIA along the Columbia River in the south. In addition to the National Forest, land uses in the WRIA include state (DNR) and private timber management operations, agriculture (especially in the eastern end of the WRIA, around the White Salmon River, Catherine Creek, and Major Creek), residential development, and hydroelectric generation.

WRIA 29 is a popular recreation destination. Water dependent recreation activities include fishing (especially on the Wind River, the lower White Salmon River, Northwestern Reservoir, and numerous lakes on the Gifford Pinchot National Forest, and


WRIA 29:
WINTER & SUMMER STEELHEAD
SPRING & FALL CHINOOK
AND COHO DISTRIBUTION
Fish Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
WRIA 29 Outline
Lakes
Marsh/Wetland/etc
WATERSHEDS
Adams-Trout Lake
Lower White Salmon
Little White Salmon
Wind
Location of WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
N
0 5 10 25 miles
2.5 7.5 12.5
Scale 1:240000
Northwest Indian
Fisheries Commission
Conservation
Commission



WIND RIVER SUBBASIN
WINTER & SUMMER STEELHEAD
SPRING & FALL CHINOOK,
AND COHO DISTRIBUTION
LEGEND
Fish Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Wind River Sub-Basin Outline
Lakes
Marsh/Wetland/etc
Wind River Watershed
T05R06E Township/Range ID
36 Section ID
Location Within WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Washington State Conservation Commission
Northwest Indian Fisheries Commission

along State Highway 14), whitewater rafting on the White Salmon River, and wind surfing on the Columbia River.

Wind River. Since construction of Condit Dam on the White Salmon River in 1913, the Wind River has been the only major anadromous fish-producing stream in the WRIA. The river's headwaters are in McClellan Meadows, approximately 20 miles north of the town of Carson Washington. It flows in a southerly direction and enters the Columbia River at approximately river mile 155, about two miles south of Carson. The River is approximately 31 miles in length and has a drainage area of approximately 143,504 acres. Its major tributaries which support anadromous fish are the Little Wind River, Trout Creek, Panther Creek, Trapper Creek, Dry Creek, and Paradise Creek.

The Wind River is the first major anadromous stream in Washington upstream of Bonneville Dam, which is located approximately 10 miles downstream of the mouth of the river.

Within its 225 square mile drainage area are 181 miles of fish bearing streams, 956 miles of non-fish bearing perennial and intermittent streams, and 293 acres of lakes and ponds (USFS, 1996).

The river supports winter steelhead, fall chinook, and possibly limited numbers of coho (USFS, 1996) and bull trout/dolly varden (Weinheimer, 1999) in its lower reaches below Shipherd Falls (River Mile 2.1) and in the Little Wind River. Summer steelhead have historically been present throughout the system, and spring chinook have gained access to the upper watershed subsequent to the construction of a ladder on Shipherd Falls in 1956 (WDW et al, 1990). Also present in the system are a number of native and non-native resident salmonid species. These include isolated populations of rainbow, cutthroat, and brook trout.

The Gifford Pinchot National Forest (GPNF) and other federal ownership accounts for 127,682 acres, or 89% of the watershed. The Washington Department of Natural resources owns 3757 acres (2%), private timber interests 8122 acres (6%), and 3943 acres or 3% are in other private ownership.

Those lands outside the National Forest ownership are generally in the lower twelve miles of the watershed. Most of the first six miles of the river and its drainage are outside the GPNF, but a large portion of this area lies within the Columbia River Gorge National Scenic Area. The town of Carson is in this portion of the watershed.

The next six miles of the main stem Wind River traverses a long, narrow area of private ownership within the GPNF boundaries. This inholding generally follows the river and ranges up to approximately one mile in width.

Current land uses within the watershed are diverse. The Wind River drainage has traditionally been managed for timber production, however, in recent years that pattern has begun to be altered. Under the Northwest Forest Plan much of the drainage has been set aside as late successional reserves, wilderness areas (wilderness areas pre-dated the Forest Plan), riparian reserves, or reserved through other means. Other land uses in the watershed include:

Urban/Residential. Carson, Washington is located approximately two miles from the mouth of the river. Stabler, Washington is approximately at river mile seven. There are individual dwellings throughout the first 12 miles of the river, with the majority located in the lower reaches. In addition a number of vacation cabins are located near Government Mineral Springs along Trapper Creek as it flows out of the Trapper Creek Wilderness. These cabins are privately owned on land leased from the USFS.

Forestry. In addition to the GPNF and DNR, there is a limited amount of commercial timber land ownership in the lower valley. Those holdings within the Columbia River Gorge National Scenic Area (NSA) are regulated by the NSA's land use regulations as administered by Skamania County. Those outside the NSA are regulated by the Washington State Forest Practices Regulations.

Industrial/Agriculture. Large-scale industrial activities are largely limited by the lack of available land outside National Forest and Scenic Area. The two major industrial operations in the watershed are a plywood mill on the east side of the river near the mouth and a lumber yard north of Carson. Both are owned and operated by the WKO Company. A gold mine is operated near the Upper Wind River approximately one mile south (downstream) of the mouth of Paradise Creek.

The GPNF closed the Wind River Nursery on Trout Creek near Stabler in 1997. Nursery lands of approximately 190 acres and the associated infrastructure are in the process of being conveyed to Skamania County.

Recreation. In recent years, recreational pressure on the basin has increased. The river's proximity to the Portland/Vancouver area and its easy access make it a popular destination. Favorite activities include snow play (cross country skiing, tubing, sledding, etc.), fishing, mineral prospecting, swimming, golf, hot springs, camping, hiking, picnicking, waterfall viewing, hunting, berry picking, and even searching for sasquatch. In addition to being a destination for recreational activities, the Wind River Valley is a significant transportation corridor for travelers whose destination may be outside the drainage. Forest Road 30, which follows the river through much of its length, offers easy access to the upper Lewis River basin and to the Mount St. Helens National Volcanic Monument and carries significant summer tourism traffic.

Physical Characteristics. The Wind River watershed exhibits a variety of geomorphic characteristics. The northwest and southwest portions of the drainage have high gradient landforms. The northeast and north portion of the drainage contains some of the highest peaks in the drainage, but is also characterized by more gentle terrain. This area contains a number of lakes, especially in the Indian Heaven Wilderness, and large wetland and marsh complexes. One of these wetlands, McClellan Meadows, in Township 6 North, Range 7 East, Section 13, is the source of the Wind River. Elevations within the basin range from in excess of 4300 feet in the Indian Heaven Wilderness to a low of 80 feet at its confluence with the Columbia River.

Trout Creek, in the southwest portion of the watershed, is bounded on the east and north by Trout Creek Hill and on the west and south by a high steep ridge that forms the divide between the Wind and the Rock Creek and Lewis River systems. Trout Creek lies in a broad valley, characterized by a series of large benches, formed as tributary streams descend from the highlands to the west and south and enter the flats of the valley floor.

Vegetative cover within the Wind River watershed is predominately coniferous forests which are even-aged (50 – 150 years) over large areas. The dominant vegetative type is the hemlock vegetative association. Most of the watershed has been harvested in the past 150 years and is currently occupied with second growth Douglas fir stands. Some remnant stands of forest in excess of 300 years in age remain, predominantly along the Trout Creek and Dry Creek drainages (USFS, 1996).

The seral stage make-up of the watershed is as follows:

a. Late successional (trees > 21" dbh with multiple canopy layers): 31,816 acres (22%)
b. Mid successional (trees > 21" dbh with a single canopy layer, and stands between nine and 21 inches dbh): 67,628 acres (47%)
c. Early successional (trees zero to nine inches dbh): 34,118 acres (24%)
d. Non-forest: 9,887 acres (7%)

The Wind River has a temperate marine climate. It is characterized by cool, moist winters and dry, moderately warm summers. The mean annual precipitation in the watershed is approximately 110 inches, 80% of which falls between the months of November and April. There are no glaciers or permanent ice fields in the drainage, and the river and its tributaries depend on groundwater and wetlands recharged by the winter rains and melting snowpack to sustain flows during the warm, dry summers.

In winter and spring, the watershed is susceptible to high peak flows from rain-on-snow events. Because of this winter/summer pattern, the Wind River can experience tremendous variations from season to season. Low flows can fall below 250 cfs (cubic feet/second) on an average late summer day in August and September, and have been measured as low as 8 cfs above the fish hatchery at river mile 18 in 1992. High flows will average over 2,000 cfs in December and January. An estimated peak flow of 54,000 cfs occurred at Shipherd Falls during the February 1996 flood event (USFS, 1996).

Land use patterns also effect flow regimes. Removal of the vegetative cover and canopy result in increased runoff, and higher peak flows, and can reduce groundwater recharge, reducing summer low flows.

White Salmon River. Condit was constructed on the White Salmon River in 1913. After two fish ladders were destroyed by high flows in the following decade, attempts to pass fish around the structure were discontinued. The dam is currently operated by PacifiCorp Corporation. Licensing negotiation are currently ongoing, and it is likely that the aging structure will be removed at some point during the next decade. Upon removal of the dam, as much as 40 miles of anadromous fish habitat will be made accessible in the main stem and tributaries above the dam.

Other WRIA 29 Streams. Most streams in WRIA 29 have limited habitat accessible to anadromous fish. The geography of the Columbia River Gorge limits the available habitat to that above the Bonneville Pool and the naturally occurring barrier of the gorge wall. The Little White Salmon River is an example of this reality. When Bonneville Dam was constructed in the 1930's, an impoundmant was created landward of State Highway 14 at the mouth of the Little White Salmon River. This impoundment is know locally as Drano Lake, and is a popular fishing spot for steelhead "dip-ins" (fish not bound for the Little White Salmon River, but stopping briefly in the lake while enroute other upstream rivers). Slack water from Drano Lake extends some distance up the Little White Salmon River.

Further up the river is an impassible 37-foot natural waterfall. The available river habitat between the upper extent of Drano Lake's slack water and the waterfall on the Little White Salmon River is approximately 500 feet. Other streams in the WRIA exhibit similar impediments to fish production.

HISTORIC PATTERNS OF HABITAT ALTERATIONS

The quantity and quality of aquatic habitat present in a any stream, river, lake or estuary is a reflection of the habitat's physical characteristics (e.g., depth, structure, gradient, and so on) as well as the quality of the associated waters (e.g., temperature and suspended sediment load). There are a number of processes that create and maintain these features of aquatic habitat. In general, the key processes regulating the condition of aquatic habitats are the delivery and routing of water (and its associated constituents such as nutrients), sediment, and wood. These processes operate at various scales over both the terrestrial and aquatic landscapes. For example, climatic conditions operating over very large scales can influence many habitat forming processes over a large area. At the same time the position of a fish in the stream channel can depend upon delivery of wood from forest adjacent to the stream. In addition, ecological processes operate at various scales of time and place. They have components that are lateral (across the stream, e.g., floodplain), longitudinal (along the stream, e.g., landslides in upstream areas) and vertical (above the stream, e.g., riparian forest).

The effect of each process on habitat characteristics is a function of variations in local geomorphology, climatic gradients, spatial and temporal scales of natural disturbance, and terrestrial and aquatic vegetation. For example, wood is a more critical component of stream habitat than in lakes where it is primarily an element of near-shore habitats. In stream systems, the routing of water is primarily via the stream channel and subsurface routes whereas in lakes, water is routed by circulation patterns resulting from inflow, outflow and climatic conditions.

Human activities degrade and eliminate aquatic habitats by altering the key natural processes described above. This can occur by disrupting the lateral, longitudinal, and vertical connections of system components as well as altering spatial and temporal variability of the components. In addition, humans have further altered habitats by creating new processes such as the actions of exotic species. The following sections identify and describe the major alterations of aquatic habitat that have occurred and why they have occurred.

Wind River. The Wind River drainage is one of marked contrasts. The north and northeast portions of the watershed contain a number of high elevation marshes and wetlands. The northwest and southeast portions are more rugged with high gradients. The southwest portion, especially in the vicinity of Trout Creek and its tributaries are characterized by high gradient headwater streams flowing into broad alluvial valleys. Ninety per cent of the watershed lies in the hemlock, silver fir, or Douglas fir vegetative zones.

Three of the defining features for anadromous fish in the Wind River watershed are fire, flow, and the presence of Shipherd Falls. All have been modified in the last 100 years.

Stand replacement fires occurred regularly in the watershed. Since 1900, fires occurred in portions of the watershed until 1930 when a policy of aggressive fire suppression was adopted. Fires altered the pattern of LWD input, erosion, and snow accumulation and snowmelt, peak flows, and summer low flows. Fires would often increase available LWD, which would dampen the negative effects of the other factors. In this century, logging replaced fire as the dominant land disturbing event. Effects of logging are similar, but often more wide-spread and intense than fire, and often severely decreases the available LWD recruitment trees (USFS, 1996).

With no glaciers or permanent ice fields, the Wind River depends on groundwater from winter rains and spring snowmelt to provide sufficient flow at low temperatures for fish survival. Peak flows in the basin during the period of 1935 to 1960 did not exceed 20,000 cfs (USFS, 1996; USFWS, WDF, 1951). In 1961 and in 1965, flows near 30,000 cfs were recorded. Peak flows exceeded 30,000 on three occasions in the 1970s ('72, '74, '78), and reached a then-high of 45,700 cfs in January 1974. Although the USGS gage at Carson was not operational during the February 1996 flood event, estimates place peak flows at 54,000 cfs. Vegetation and land altering activities in the mid- and later 1900s have clearly had an affect on flows in the basin.

The USFS demonstrates the shift in the vegetative maturity of the watershed over the last 150 years in their 1996 watershed analysis:

Year	Non-Forest	Early Successional	Mid Successional	Late Successional
circa 1850	5%	28%	9%	58%
circa 1900	5%	15%	36%	44%
present	7%	24%	47%	22%

A 1951 report prepared by the USFWS and the Washington Department of Fisheries describes numerous log and debris jams throughout the watershed, indicating the presence of a plentiful supply of LWD.

Historically, Shipherd Falls was a blockage for all anadromous fish except summer steelhead. Summer steelhead would spawn and rear throughout much of the watershed without competition from other anadromous species. However, unlike salmon, most steelhead do not die in their natal streams immediately upon spawning. Though approximately 85% to 95% will suffer mortality after spawning, most will die while returning to saltwater or after having arrived there. Because of this fact, combined with the historic lack of natural salmon runs in the upper river, the Wind River likely had few fish carcasses, and therefore may have naturally lacked the nutrient input from this source (Rawding, 1999).

CONDITION OF NATURALLY SPAWNING POPULATIONS

The streams and rivers of WRIA 29 support several species and stocks of anadromous and resident fish. Anadromous run size may be affected by a number of different factors. Quantity and quality of available spawning and rearing habitat, freshwater flow patterns, predation, ocean conditions, commercial and sport harvest, and a host of other factors contribute to determining the number of fish in a given run which survive to return and spawn.

The role of habitat or any other single factor in determining the number of fish in a given stock is usually somewhat unclear, and varies from system to system and stock to stock. What is clear is that each factor plays its role. Disrupting and degrading habitat will reduce the number of fish produced in a system over time. As each factor takes its toll, the cumulative effect may cause a severe decline in fish produced by a system.

The following snapshot of stock status is intended to serve as background to the habitat discussion. While certainly not the only factor affecting the health of a particular stock, changes in habitat and its carrying capacity is certainly a significant element as a fish run declines or moves toward restoration.

Wind River. The Wind River supports a number of both resident and anadromous fish species. Historically, summer steelhead, winter steelhead, coho, fall chinook, chum, and searun cutthroat were present in the basin. Spring chinook were introduced into the river in 1952 (WDW, 1990).

Shipherd Falls, a series of falls totaling about 40 feet at present-day river mile 2.1 was a historic blockage to all species except summer steelhead. Historic summer steelhead runs in the Wind River basin may have ranged between 2,500 and 5,000 fish. The 1992 Salmon and Steelhead Stock Inventory (SASSI) rerport by the Washington Department of Fish and Wildlife (WDFW) rated Wind River summer steelhead as “depressed.” Summer steelhead spawning escapement for the Wind River watershed between 1985 and 1989 averaged 574 fish, or 37% of the target of 1557. During the 1991 – 1993 period, escapement had further fallen to an average of 222 fish, 14% of the target. Escapement has remained well below target through the second half of the 1990’s. The 1997 SASSI update has reclassified the stock as “critical.”

Spring chinook were introduced into the watershed in 1952 and may not have been present in the watershed prior to that time. In 1956, a fish ladder was constructed at Shipherd Falls, providing access for spring chinook to the upper watershed. Since their introduction into the watershed, spring chinook have been managed primarily as a hatchery stock. Naturally spawning spring chinook averaged 156 fish from 1977 to 1987. Spawning for these fish primarily occurs from early August to mid-September in the mainstem Wind River from river mile 12 to the mouth of Paradise Creek. Summer low flows in the Wind River, often exacerbated by water withdrawls for the Carson National Fish Hatchery, may limit spring chinook production.

A small run of winter steelhead have historically used portions of the lower river below Shipherd Falls. It is believed that the run has always been relatively small in numbers. The limited available spawning and rearing habitat between the mouth and the falls and in the Little Wind River limit the number of fish that can be produced. At present, little is known about this stock, and annual returns are estimated to be about 60 fish (WDW et al, 1990). Escapment goals have not been established for Wind River winter steelhead. The 1992 SASSI report classified this stock as “unknown.”

The Wind River supports native runs of fall tule and fall bright chinook. Historically, they spawned in the lower river between the mouth and Shipherd Falls, an area approximately four miles in length. Upon completion of Bonneville Dam in 1938, the lower 1.5 to two miles of the river was flooded and spawning habitat was reduced to a stretch of river approximately two miles in length. Reports from hatchery records from the late 1940s indicate a run size of approximately 1500 fish (USFWS and WDF, 1951). Subsequent to the construction of the fish ladder at Shipherd Falls, fall chinook have been reported as far upstream as the Carson National Fish Hatchery at river mile 18, but the bulk of fall chinook spawning still occurs in the lowest two miles of the river. Wind River tule fall chinook escapement averaged 551 fish between 1967 and 1991, with a high of 1845 in 1971 and a low of 11 fish in 1990. The 1992 SASSI report rates Wind River tule fall chinook as “depressed,” and brights as “healthy.”

The Wind River may have historically supported small runs of coho and chum salmon as well as sea run cutthroat trout and bull trout/dolly varden. However data on run sizes and specific spawning locations are not available. Spawning for all of these species would likely have been limited to the mainstem of the Wind below Shipherd Falls and possibly portions of the Little White Salmon River. Coho, sea run cutthroat, and bull trout/dolly varden may still exist in the lower river, but little is known about these stocks. Straying from other systems may also account for their presence in the Wind.

Other WRIA 29 Streams. Many other streams in WRIA 29 have small anadromous populations. Most streams have little information available on current or historic run sizes.

In conjunction with negotiations for removal of Condit Dam some amount of historical data has been developed on estimated run sizes above the facility. As this dam is unlikely to be removed in the next seven years (and therefore prior to several iterations of this report), information on pre-1913 fish runs on the White Salmon River is not included. Since construction of the dam, fish runs in the lower White Salmon river (below Condit Dam) are estimated at 5489 coho, 625 chinook, and 763 steelhead (WDW et al, 1990).

WRIA 29 LIMITING FACTORS AND ASSOCIATED SITE PROBLEMS

As discussed previously, Limiting Factors are defined in this report as "conditions that limit the ability of habitat to fully sustain populations of salmon." Limiting Factors in WRIA 29 are generally grouped into four categories: Channel Conditions, Passage, Water Quality, and Water Quantity.

"Channel Condition" refers to the physical habitat components necessary in a stream to support salmonids. These components include appropriate pool/riffle ratios, deep pools, access to floodplain and side channels for rearing and for water storage capacity during flood events, appropriate amounts of clean spawning gravel, and other factors. The concept of "channel complexity" is captured in this category.

"Passage" refers to the ability of adult fish to access spawning habitat, and for juveniles to move within the system and to out-migrate as adults. Artificial barriers to passage include improperly sized or installed culverts, dams and diversions, dikes and levees, high and low flow conditions, thermal gradients, and other human-caused factors. In addition to hampering the free movement of the various fish species within a system, passage barriers may also disrupt the mobility of prey species such as crayfish, and the movement of spawning gravel through the system.

"Water Quality" refers to the actual condition of the water in which the fish live. Salmonids require cool, clean water for optimum survival. Factors of water quality include the amount of dissolved oxygen, nutrients (such as fertilizer and manure), temperature, toxics, turbidity, and others.

"Water Quantity" refers to the amount of water flowing through the system and the timing of those flows. Factors include increased peak flows, decreased base flows, seasonal hydraulic changes, short term fluctuations (often called ramping), and others.

Site Problems. Commonly, a Limiting Factor will be caused by one or more contributing problems. These "Site Problems," as we call them in this report, are conditions which in-and-of themselves may not limit fish production, but which cause or contribute conditions which do. For example, the removal of a stream's riparian zone may not have a direct impact on fish, yet may help destabilize the bank, which will in turn cause the input of excessive fines in downstream spawning beds. The same riparian zone can have adverse impacts on pool formation (through loss of LWD input), excessive temperatures through loss of shade and increased stream width-to-depth ratios), increased sediment and non-point pollution (through stormwater impacts), altered flow regimes, and even increased predation (through loss of cover from decreased bank and channel complexity and the loss of hiding cover).

When evaluating Limiting Factors for correction, the appropriate place to focus restoration efforts will often be on Site Problems, and not the Limiting Factor itself. Creating off-channel rearing channels is of little use until the condition which is eliminating such habitat is corrected. Once correction of the contributing site problem is underway, intervention in the Limiting Factor may be entirely appropriate.

In a climate of limited financial and physical resources, it is important to target restoration efforts on those sites which will return the greatest benefit for fish. Correcting one problem in the system when a different factor is more critical and limiting may not pay off by ultimately producing an increase in the number of smolts leaving the system.

Items to be considered in a ranking process would include access to the site for fish (i.e., the absence of downstream barriers), the critical nature of the impacted habitat, the extent of the severity of the impact, and the relative contribution of the individual Site Problem to the Limiting Factor. To this end, a process has been employed to score and rank individual Site Problems. The following is a guide to scoring and ranking Site Problems. Scored and ranked lists of site problems are included in each stream's section.

1. Site Problem: The condition to be fixed. Ultimately contributes to one or more Limiting Factors.

2. Number of Stocks Affected: The number of species/stocks affected by the Limiting Factor(s) to which the Site Problem contributes. *One point per stock.*

3. Stock Status: How many of the affected stocks are listed under the ESA or listed as critical or depressed in SASSI? *One point per listed (ESA or SASSI) stock.*

4. Blockages Below: How many blockages exist below the impacted habitat? A blockage is counted if it is physically below the limiting factor being addressed. For example, think of a system with a failing bank, excessive fines in the spawning gravels, and an impassable culvert. If the culvert is below the spawning grounds, then it is counted. If it is above the spawning grounds, it is not counted, whether above or below the failing bank. *One point for no blockages, zero points for one blockage, and one less point for each additional culvert. Partial blockages count one half point.*

5. Stream Miles Affected: How many miles are affected by the Site Problem? For blockages, miles blocked are counted. For other Site Problems, length of the problem is counted.

6. Contributes to Clean Water Act Standard Exceedences: Does the Site Problem contribute to water quality exceedences under the Clean Water Act? *Yes = one point; No = zero points.*

7. Number of Limiting Factors: How many Limiting Factors does the Site Problem contribute to? *One point per Limiting Factor.*

For the next three questions, a scoring system of High, Medium and Low was employed. *High – five points, Medium = three points, Low = one point.*

8. Severity of the Limiting Factor Impact: How severe is the impact of the Limiting Factor on fish habitat?

9. Relative contribution of the Site Problem to the Limiting Factor: How much of a role does the individual Site Problem play in the Limiting Factor, relative to other contributing Site Problems?

10. Critical Nature of the Habitat (bottleneck): How limiting (critical) is the habitat in the system?

Add the values for categories 2 – 10 for the final ranking.

Individual Stream Limiting Factors and Site Problems. In the following section, Site Problems on the Wind River are (1) ranked in order of importance to fish impacts, (2) listed by sub-basin and displayed in relation to the Limiting Factor or Factors to which they contribute, (3) mapped, and (4) discussed in a narrative section. As the major fish-producing river in the WRIA, only the Wind River Site Problems have been ranked. Limiting Factors and Site Problems on other streams are listed separately on the following page and are included in the discussion section.

Wind River:

Figure 4: Wind River Limiting Factors

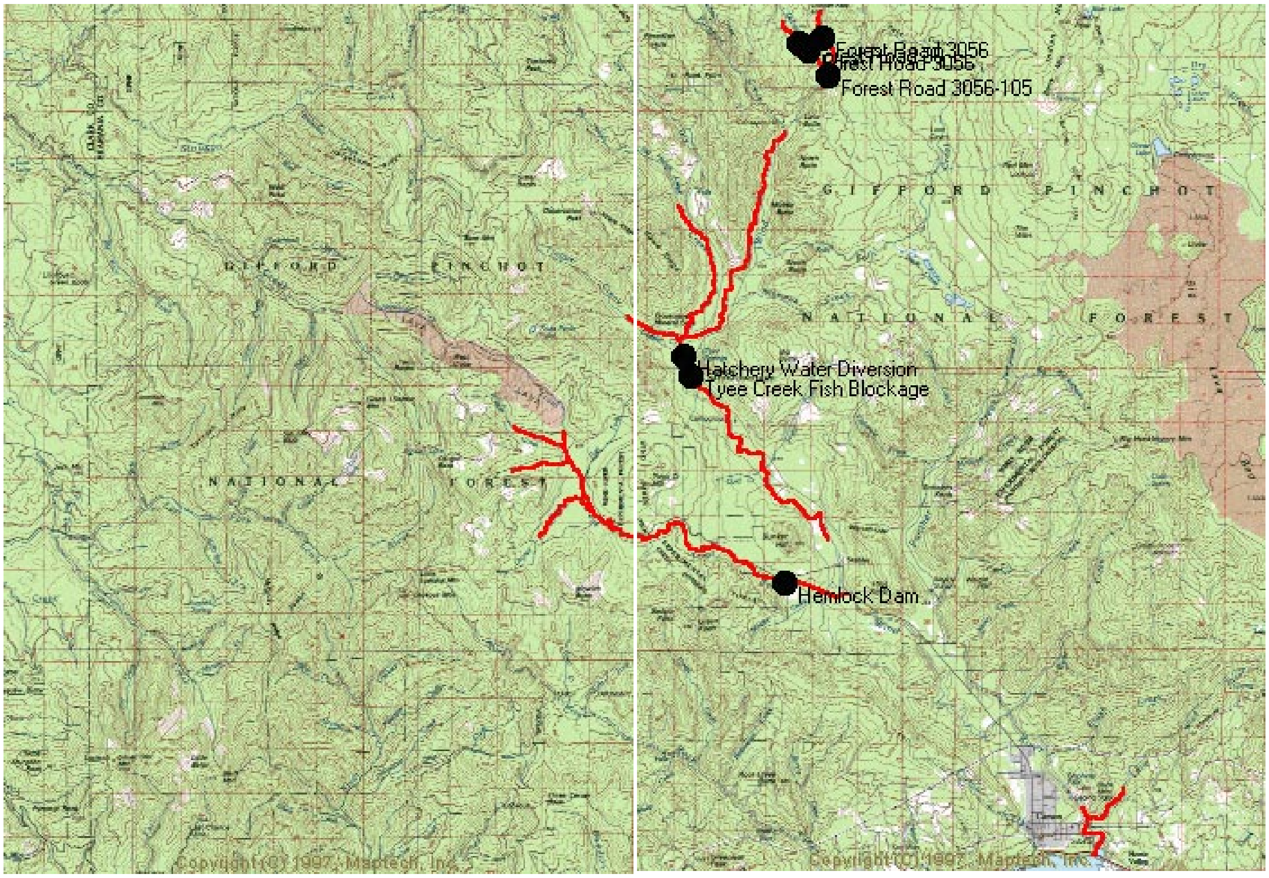


Table 1: Site Problem Ranking for the Wind River.

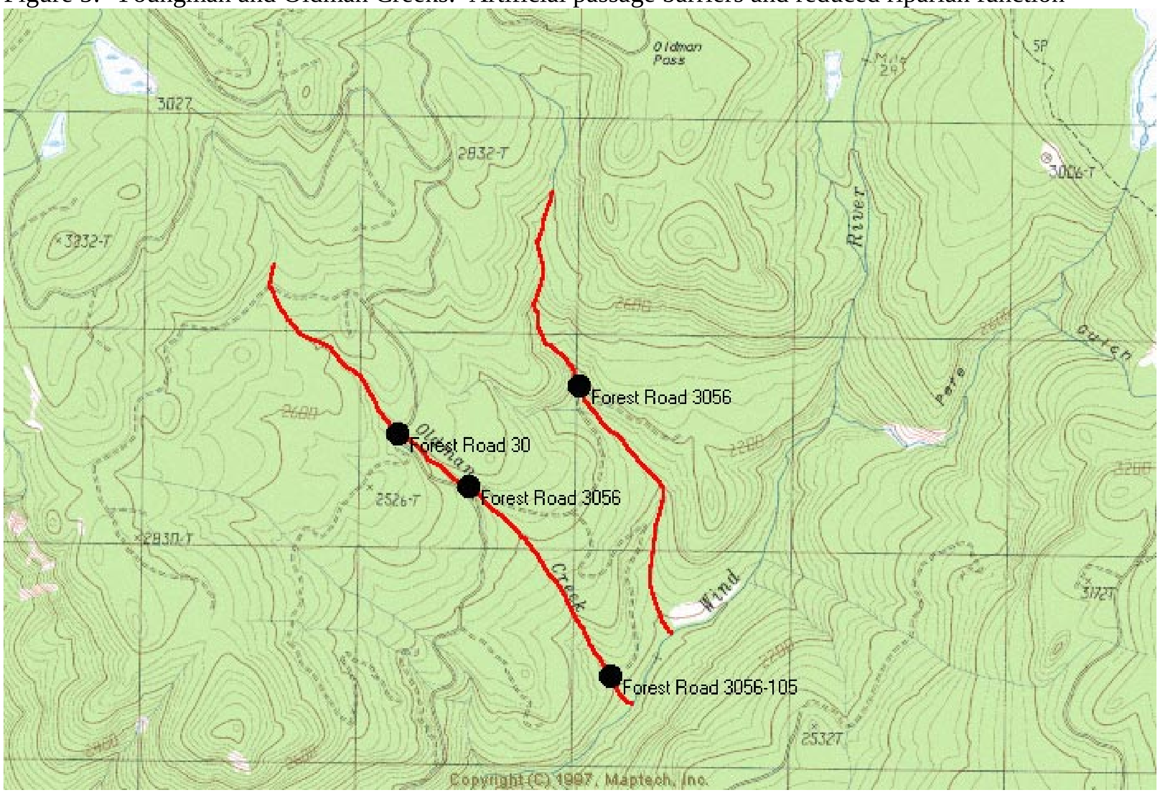
Site Problem / Score	
1. Hemlock Dam	71.0
2. Trout Creek Riparian	28.1
3. Trout Creek Channel Downcutting	27.1
4. Trout Creek LWD Removal	27.1
5. Middle Wind Floodplain	27.0
6. Layout Creek Riparian Zone	26.8
7. Compass Creek Riparian Zone	26.2
8. Upper Wind Riparian	26.0
9. Crater Creek Riparian Zone	25.3
10. Middle Wind Riparian	25.0
11. Middle Wind LWD	25.0
12. Layout Creek LWD Removal	24.8
13. Layout Creek Channel Downcutting	24.8
14. Compass Creek LWD Removal	23.2
15. Crater Creek LWD Removal	23.0
16. Dry Creek Riparian Zone	22.4
17. Dry Creek LWD Removal	21.4
18. Compass Channel Downcutting	21.2
19. Crater Creek Channel Downcutting	21.0
20. Paradise Creek Mass Wasting	21.0
21. Upper Wind Diking/Road	20.0
22. Youngman Creek Riparian Zone	18.7
23. Middle Wind Water Diversion	18.5
24. Oldman Creek Riparian Zone	17.1
25. Trapper Creek Channelization	17.0
26. Trapper Creek Floodplain Filling	17.0
27. Trapper Creek Channel Constriction	17.0
28. Tyee Creek Diversion	17.0
29. Lower Wind Mass Wasting	16.5
30. Little Wind Mass Wasting	15.5
31. Trapper Creek Diking	15.0
32. Trapper Creek Channel Downcutting	14.0
33. Oldman Creek Culvert #1	14.0
34. Wind Mouth Sediment	13.5
35. Oldman Creek Culvert #2	12.3
36. Youngman Creek Culvert	11.8
37. Oldman Creek Culvert #3	11.0

Site Problem Discussion. This section is organized by sub-watershed, starting with the uppermost tributary with identified site problems and/or limiting factors.

Youngman Creek. Youngman Creek enters the Wind River at river mile 27. Anadromous passage is blocked by a culvert on Forest Road 3056, at stream mile 1.2. Approximately ¾ mile of steelhead rearing habitat is blocked.

Youngman Creek has been found to have an excessive level of fine sediment from Stream Mile 0.0 – 1.7. The principle Site Problem associated with this increased sediment load is the loss of riparian cover through timber harvest in the same area.

Figure 5: Youngman and Oldman Creeks: Artificial passage barriers and reduced riparian function



Oldman Creek. Oldman Creek enters the upper Wind at river mile 26.8. Access to much of Oldman Creek is blocked by a series of three culverts. The first is on Forest Road 3056-105, has a 10 foot drop at the outlet and is approximately ¼ mile above the mouth. The second is on Forest Road 3056, at approximately stream mile 1.0, and the third is on Forest Road 30 at stream mile 1.25. In total, the three culverts block approximately one mile of suitable summer steelhead spawning habitat and two miles of rearing habitat.

Wind River; Mining Reach. The river is disassociated from the floodplain by Forest Road 30 from River Mile 21 to River Mile 25.

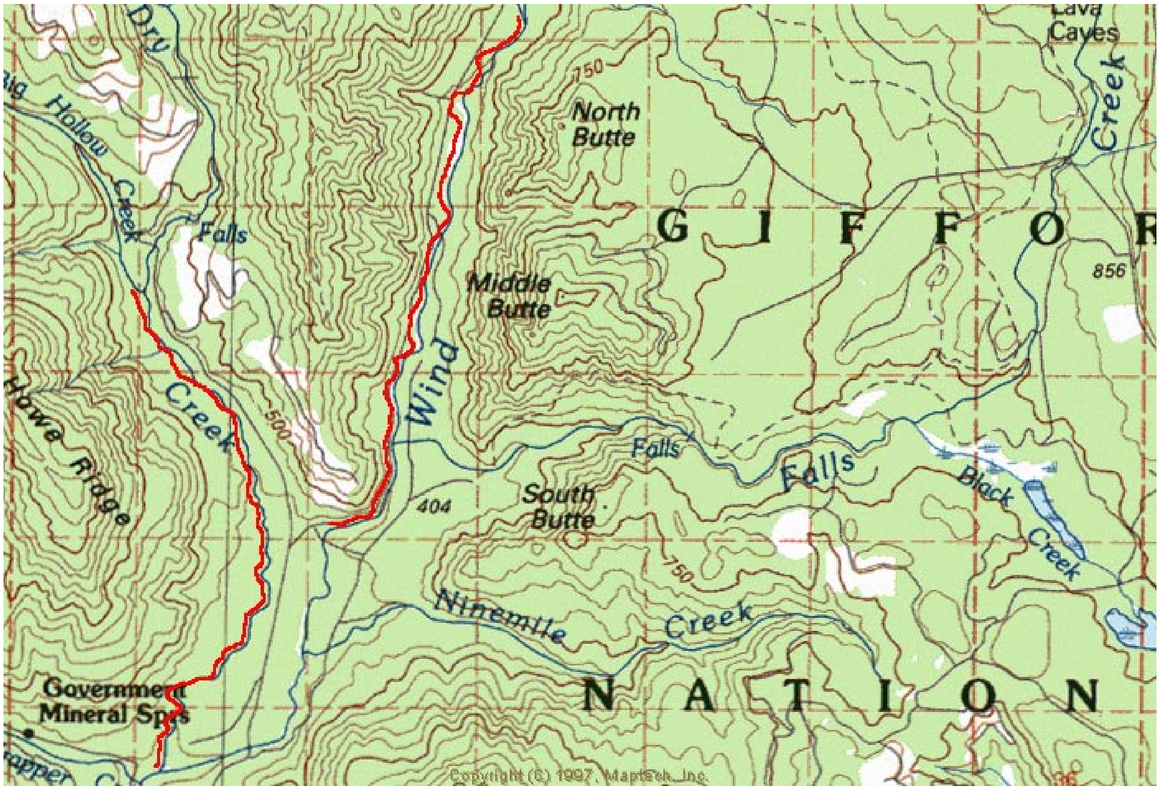


Figure 6: Dry Creek: Loss of riparian function. Wind River: Loss of floodplain connectivity

Dry Creek. Dry Creek enters the Wind at river mile 19.1. As its name implies, much of Dry Creek becomes subterranean during summer low-flow periods. Steelhead present in the system may become stranded and killed in isolated pools. Dry Creek has excessive bedload (coarse sediment) transport through its first 4.4 miles. This is caused, at least in part by the loss of riparian zone through timber harvest and the direct removal of LWD in past stream clean out projects.

Trapper Creek. Trapper Creek enters the Wind River at river mile 18.9. In the 1920s a large hotel and campground were developed to serve the many visitors attracted to Government Mineral Springs near the mouth of Trapper Creek for the believed healthful benefits of the water. In time a total of 46 cabins were constructed on lower Trapper Creek as part of the tourist complex. Today, the hotel is gone, but the 46 cabins remain and are individually privately owned as vacation cabins. The land is leased from the GPNF and the cabins operate based on a Forest Service Special Use Permit. The cabins are on both banks of Trapper Creek and extend approximately from stream mile 0.25 to stream mile 1.25. Many of the cabins are within 200 feet of the creek. A number of them encroach onto the floodplain. In some cases, high flow channels can be observed landward of the cabins, and active filling is necessary to maintain the cabins and the surrounding property.

A number of the Government Mineral Springs cabins form channel constrictions, decreasing flow velocities upstream which causes the stream bed to aggrade, and in turn increasing flow velocities downstream, causing stream bed scour and adding to bank instability throughout the affected reach.

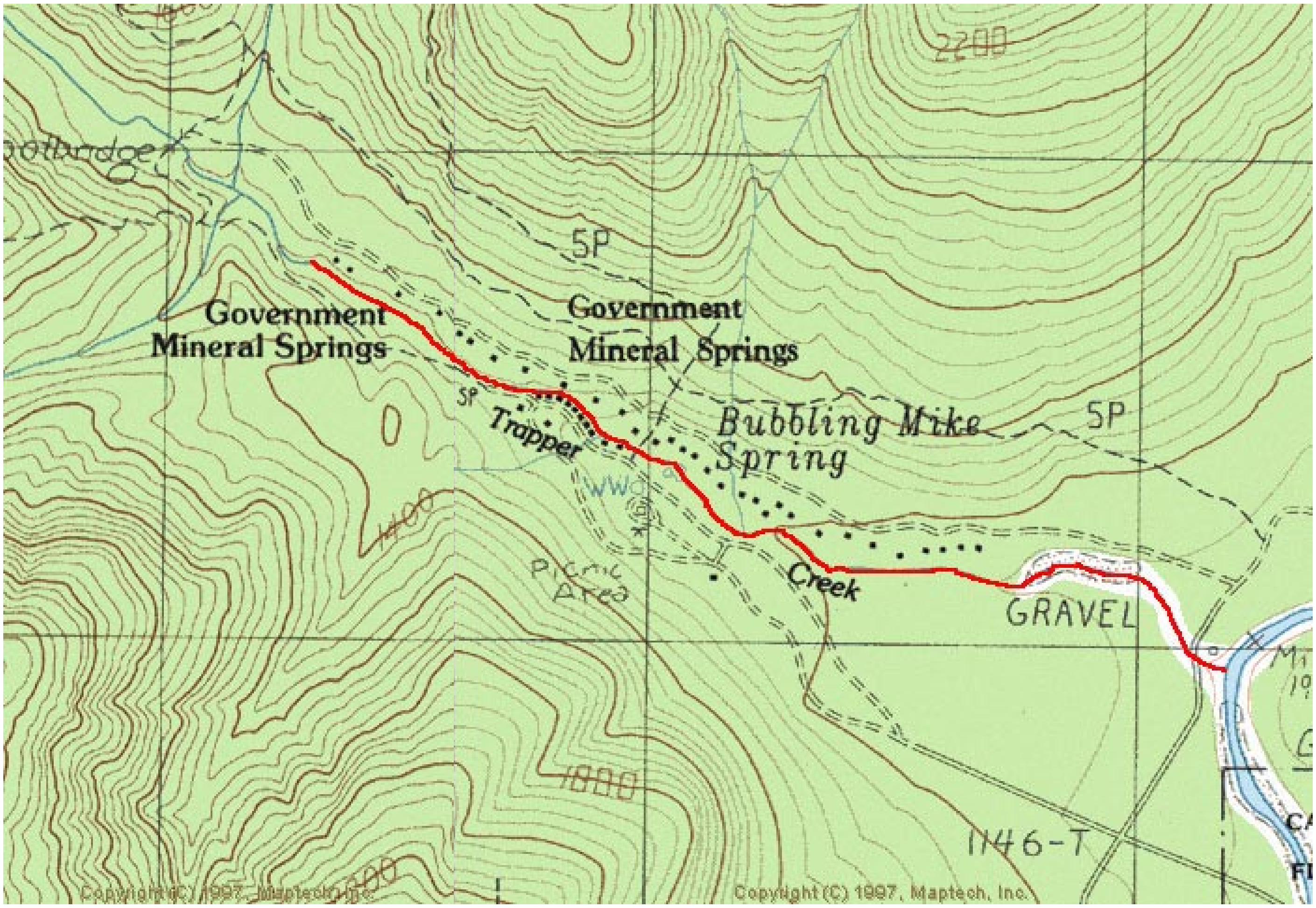


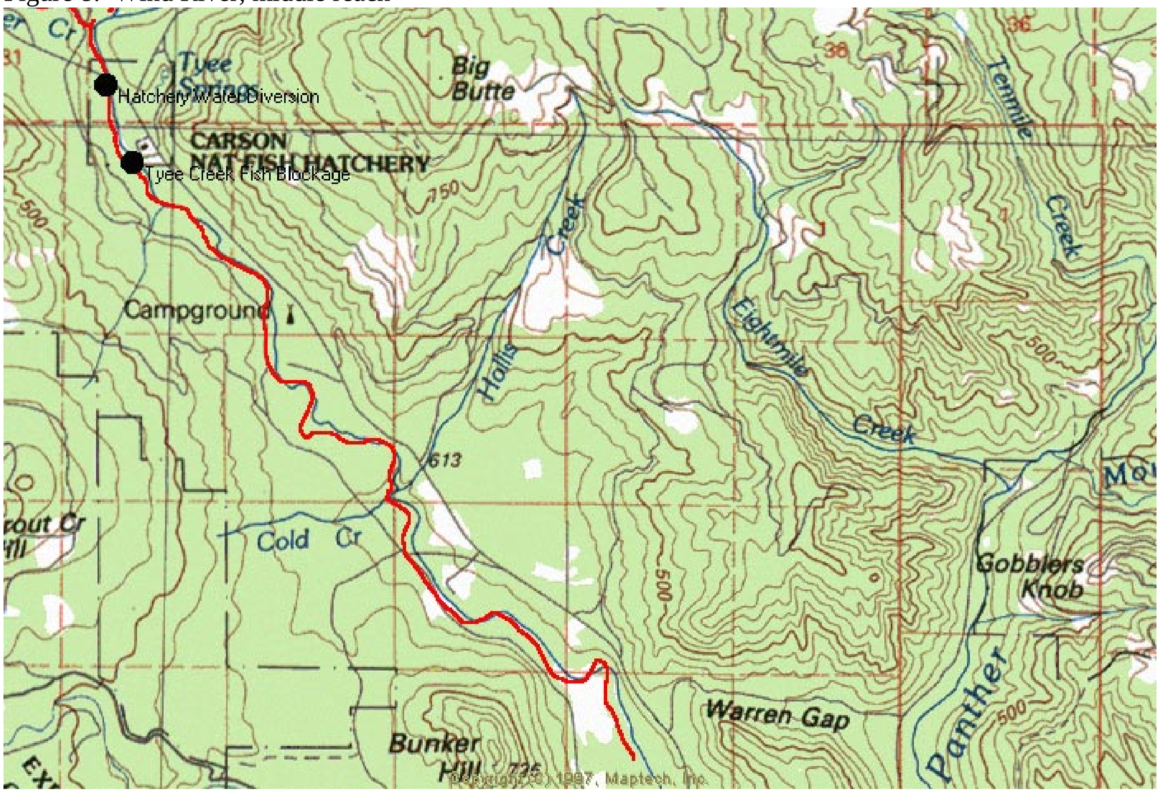
Figure 7: Trapper Creek

Wind River; RM 12 – 19. The mainstem Wind River has largely been disassociated from its floodplain from approximately River Mile 12 (in the vicinity of Stabler, Washington) to River Mile 19 in the vicinity of the Government Mineral Springs Bridge. Land uses that have impacted the functionality of the floodplain include residential development near Stabler, the development of the Beaver campground, construction and maintenance of Forest Road 30, and diking to protect the Carson National Fish Hatchery. Some amount of dike removal and floodplain restoration has occurred in the vicinity in recent years.

The Carson National Fish Hatchery has a water diversion in the main stem Wind River to supplement their water supply. The diversion is used in summer months when flow in Tyee Creek is insufficient to meet hatchery needs. Withdrawl of water from a system which is already limited by summer low flows may adversely affect the ability of spring chinook to spawn in or pass through the by-pass reach. Recent modifications to withdrawl methods may have improved conditions.

Tyee Creek. The Carson National Fish Hatchery uses Tyee Creek as a water source and is a total blockage for anadromous fish passage into the creek. Tyee Creek is approximately ¾ mile long and is suitable for spawning and rearing for both steelhead and chinook. Hatchery design and construction and disease concerns may make correction difficult.

Figure 8: Wind River, middle reach

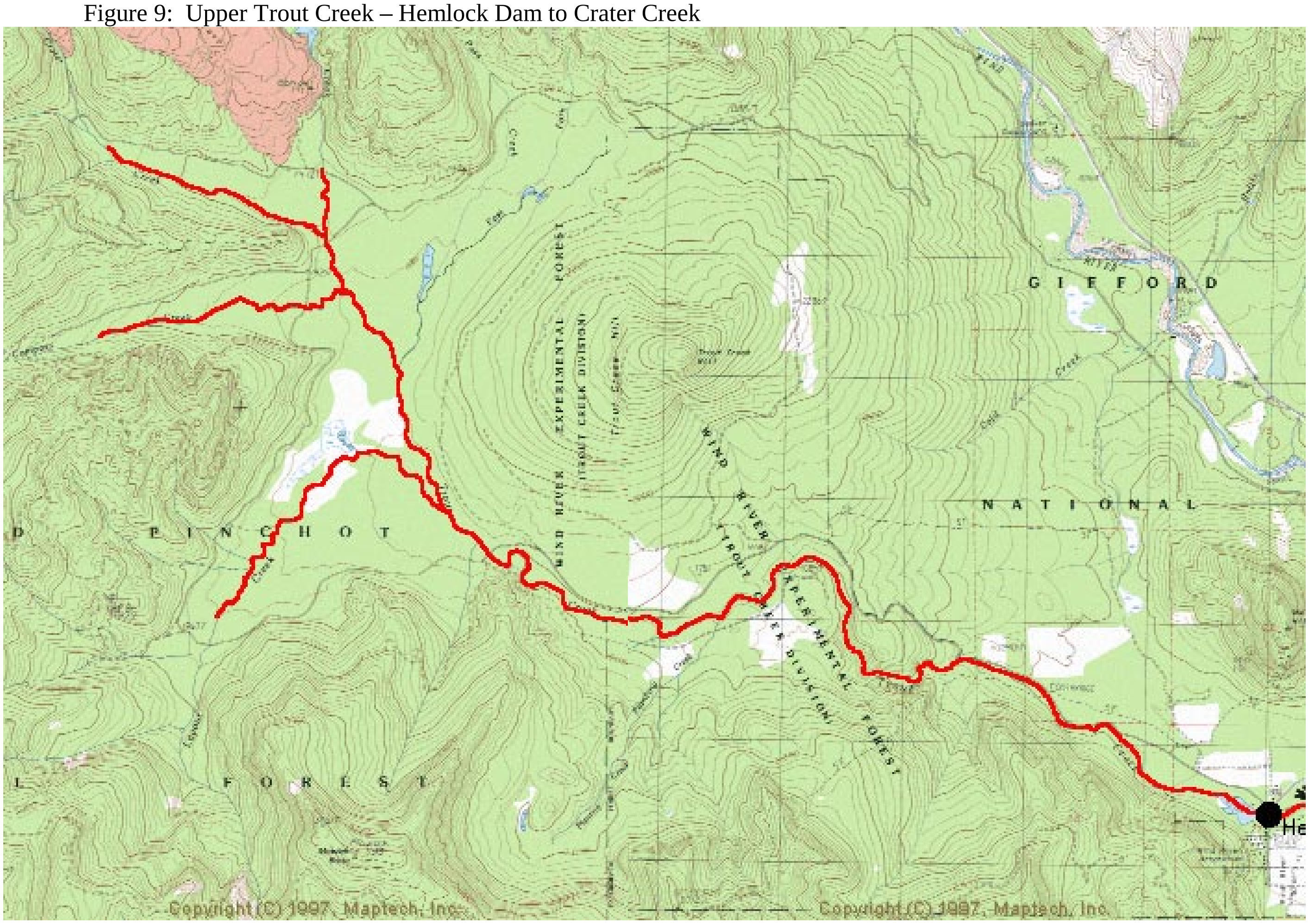


Trout Creek Drainage. Trout Creek and several of its tributaries have been severely impacted by the deposition of fine sediment, increased temperatures, decreased pool frequency and lack of deep pools, and a loss of floodplain function. Trout Creek is bounded on the east and north by Trout Creek Hill and on the west and south by a high steep ridge that forms the divide between the Wind and the Rock Creek and Lewis River systems. Trout Creek lies in a broad valley, characterized by a series of large benches, formed as tributary streams descend from the highlands to the west and south and enter the flats of the valley floor. Due to its flat, accessible topography, Trout Creek and several of its tributaries have been extensively managed for timber production over the last century. Many riparian zones have been severely degraded and LWD has been directly removed from the basin in past fishery "improvement" projects. High, fast flows descending from the surrounding highlands enter the relatively flat area at the foot of Trout Creek Hill, and area with little riparian or in-stream structure. The resulting stream channel downcutting and bank failures contribute large amounts of fine sediment to the system, disassociate streams from their floodplains, and contribute to increased temperatures and decreased pool frequency throughout the drainage. The lack of instream structure due to past stream clean outs tends to accelerate the processes. Streams in this system that are similarly impacted include:

a. Trout Creek, Stream Mile 1.8 – 9.4.
b. Crater Creek, Stream Mile 0.0 – 1.5
c. Compass Creek, Stream Mile 0.0 – 1.7
d. Layout Creek, Stream Mile 0.0 – 2.3

Hemlock Dam. Hemlock Dam is a 20 foot concrete structure on Trout Creek at stream mile 1.8. It was constructed in 1935 by the Civilian Conservation Corps, and provided

Figure 9: Upper Trout Creek – Hemlock Dam to Crater Creek



water to the USFS Wind River Nursery. Though it was constructed with a fish ladder, it has been identified as a passage obstruction for out-migrating juvenile steelhead, and possibly for returning adults.

The dam's weir and pool type fish ladder was constructed along with the dam itself in 1935 and has serious flaws and limitations. Insufficient attraction flow at high flows is a significant problem. Fish may be hampered from finding the ladder on the right bank when high flows are spilling over the dam. Other deficiencies include poor pool design, difficulty in adjusting water volumes, and debris accumulation.

Out migrating juveniles are presented with a number of obstacles at the dam. First, no specific downstream passage facility exists. Juveniles have been observed to congregate at the dam crest during migration season. Others find their way into the ladder and are delayed as they have difficulty negotiating the structure.

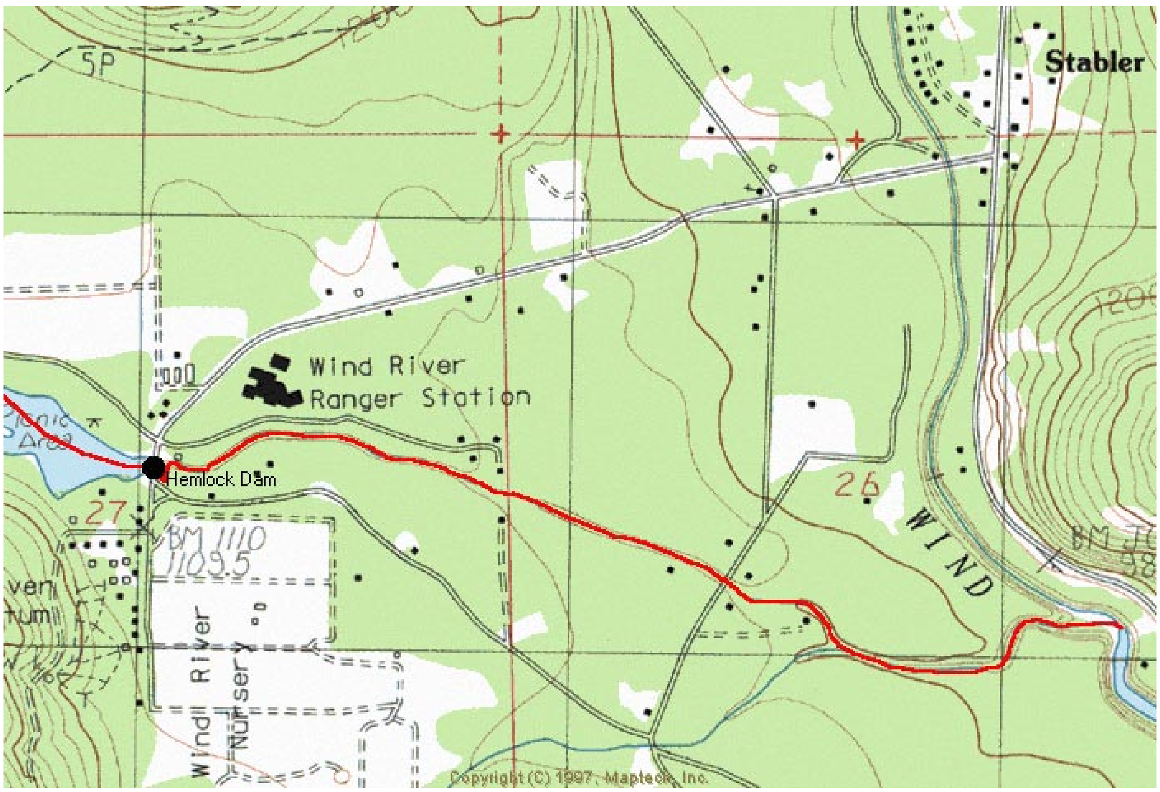


Figure 10: Lower Trout Creek – Mouth to Hemlock Dam

Juveniles suffer direct mortality through the operation of seasonal flashboards, constructed annually to increase pool capacity. The boards do not form a watertight seal and water is forced through small cracks in the structure. Juvenile fish are unable to resist the high velocities when caught in the flow and die when impinged in the structure.

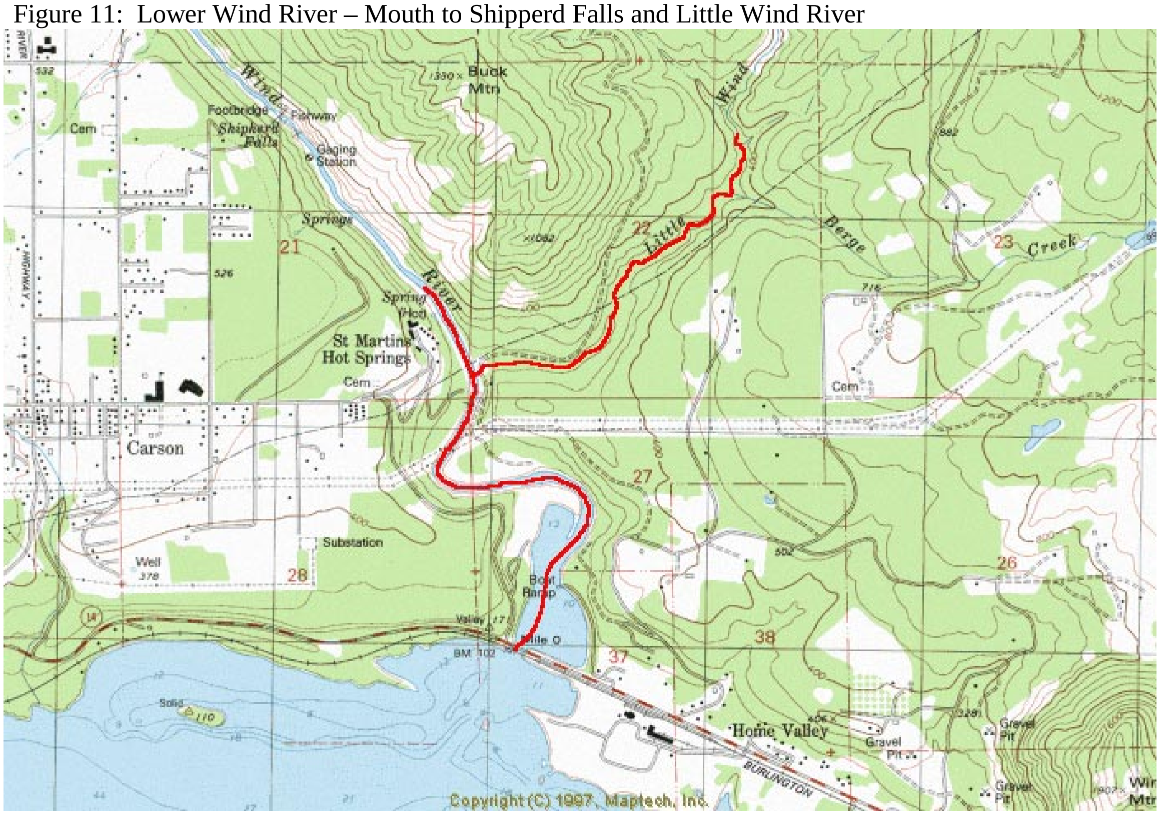
Over the years, Hemlock Dam's reservoir has slowly filled with sediment transported down the Trout Creek system. In its current condition, the reservoir is a wide, shallow pool with little shading available at the margins. Surface water temperatures in excess of 80° F have been measured in waters associated with Hemlock Dam (Bair, 1999).

Little Wind River. Two specific sources of fine sediment on the Little Wind River are a number of landslides associated with a gas pipeline from Stream Mile 0.5 – 1.5 and with a timber harvest from Stream Mile 0.0 – 0.75.

Lower Wind River. In addition to receiving the cumulative sediment from the above and a number of smaller sources, there are four identified landslide sites below Shipherd Falls. These include the Sand Hill Road slide, the Hot Springs Trail slide, an erosion feature at the Carson Golf Course, and an erosion feature at the Carson Hot Springs Resort. Additional identified sediment-producing sites include a slide on Paradise Creek (stream mile 2.3) and from a slide area in Pete's Gulch.

The mouth of the Wind River has been severely impacted by a large accumulation of sediment. Sediment transported downstream is deposited at the mouth when flows from the river meet the slack water caused by Bonneville Dam pool. Impacts of this large sediment load on fish is not known. Temperature and passage concerns may result from low flows encountering this sediment in the late summer and early fall. Further investigation of potential impacts may be appropriate.

Figure 11: Lower Wind River – Mouth to Shipperd Falls and Little Wind River



Other WRIA 29 Streams

Table 2: Site Problems for other WRIA 29 streams (Listed by drainage - west to east).

Site Problem / Score

1. Foster Creek Culvert
2. Foster Creek Dam/Pond
3. Rock Creek Landslides (DNR 2000 Road)
4. Nelson Creek Runoff
5. Nelson Creek Residential Development Impacts
6. Carson Creek Bedrock Cascade
7. Carson Creek Stormwater Impacts
8. Collins Creek Culvert
9. Grant Lake Creek Upper Basin Landslides
10. Dog Creek Low Flow
11. Little White Salmon River Upper Watershed Logging Impacts
12. White Salmon River; Condit Dam
13. Jewett Creek Culvert
14. Jewett Creek Cascade
15. Jewett Creek Stormwater Impacts
16. Dry Creek Stormwater Impacts
17. Spring Creek Chlorine Input Source
18. Major Creek Low Flows

Rock Creek and Foster Creek. Both are tributaries to Rock Creek Cove in Stevenson, Washington, at Columbia River mile 150. Rock Creek enters at the east end of the cove, and the shorter Foster Creek at the west end.

Rock Creek exhibits turbidity and excess coarse bedload transport as a result of multiple landslides in the upper watershed, especially along the Washington DNR 2000 Road. Low summer flow and excessive summer temperature are also suspected as limiting in the system. Available habitat is limited by a falls, impassible to all species, approximately one mile above the creek's mouth at Rock Creek Cove.

Foster Creek, which flows down from the vicinity of Skamania Lodge, in its short length has two blockages. The first is a culvert under a county road which fails to meet WDFW standards for fish passage and is a partial barrier. The second is a dam and pond that is a total barrier. Less than ¼ mile of habitat is believed to be blocked.

Nelson Creek. Nelson Creek enters the Columbia at river mile 151.5. It is a small stream with limited available habitat. Turbidity due to road runoff and land development may further limit the amount of spawning and rearing habitat available.

Carson Creek. Carson Creek flows through the town of Carson, Washington west of the Wind River and enters the Columbia at river mile 153.5. Approximately 100 feet upstream from its mouth, Carson Creek passes through a steep, natural bedrock cascade that is believed to be a total barrier to salmon, but which may be passable to steelhead.

Turbidity and low summer flow may be limiting in Carson Creek. Site Problems contributing to the turbidity include urban stormwater runoff, roads, logging impacts, and landslides. Low summer flow may be a natural condition owing to the small size of the drainage, exacerbated by logging and development.

Collins Creek. Collins Creek enters the Columbia River at river mile 157.9. A culvert under the Burlington Northern railroad near the stream's mouth does not meet WDFW standards for fish passage and may be a partial barrier.

Grant Lake Creek. An un-named stream, sometimes known as Grant Lake Creek, flows into Grant Lake at Columbia River mile 158.4. The stream has a small run of winter steelhead. Anadromous production may be limited by an excess of fine sediment from a number of natural landslides in the upper basin.

Dog Creek. Dog Creek enters the Columbia at River Mile 160.8. The primary limiting factor to the small anadromous runs in Dog Creek is low summer flow. Dog Creek is dry through most summers, forcing juveniles to seek refuge in neighboring streams. The low flow is likely a natural condition, but may be exacerbated by a build-up of gravel at the mouth of the stream as a result of the Bonneville Pool.

Little White Salmon River. Natural production in the Little White Salmon River is limited by a falls at approximate stream mile two, and by the effects of Bonneville Pool and Drano Lake, an impoundment isolated from the Columbia River by the construction of the Burlington Northern Railroad and State Highway 14. A total of approximately 400 – 500 feet of river habitat is available between the upper limit of slack water from Drano Lake and the falls. Turbidity can be a factor during rain events due to extensive past logging in the upper watershed on the Gifford Pinchot National Forest.

White Salmon River. Anadromous fish passage on the White Salmon River is blocked at Condit Dam, a hydroelectric facility constructed in 1913 and currently operated by PacifiCorp. Factors limiting the natural production of salmon and steelhead in the White Salmon River are principally attributable to the dam.

Condit Dam blocks all passage to anadromous fish above river mile 3.3. Prior to its construction steelhead, coho and chinook were able to access Buck, Gilmer, Indian, and Rattlesnake Creeks as well as the mainstem White Salmon up to a falls at rivermile 16. Steelhead may have been able to negotiate the falls at optimal flows, and would have had access to the upper White Salmon, including the network of tributaries in the vicinity of Trout Lake, Washington. In all, as much as 40 miles of anadromous habitat may have been blocked by Condit Dam.

Limiting factors below Condit Dam include a lack of coarse substrate for spawning, a lack of pools and channel complexity (owing to a lack of large wood debris), low flow in the 2-mile by-pass reach, tailrace attraction, and stranding due to project ramping.

Jewett Creek. Jewett Creek enters the Columbia River at the town of Bingen, Washington (Columbia River mile 170.6). Near its confluence with the Columbia, Jewett Creek passes through a culvert with a surge pond at the upper end. The culvert does not meet WDFW fish passage standards, and may be a partial barrier to anadromous fish passage.

Approximately 320 yards upstream from its confluence with the Columbia, Jewett Creek passes under State Highway 14. The culvert through which the creek passes under the highway was recently replaced with a bottomless arch. In the process of replacing the culvert, a section of the stream was over-steepened. Approximately 100 yards of the stream above the culvert runs through a series of steep cascades with the lower portion reaching as steep as 50%.

Turbidity and excess fines have been observed as possible limiting factors in the creek. Sediment input originates from three major sources in the drainage.

The first source is from urban runoff from the city of White Salmon. Stormwater conveys silt from city streets, exposed soil in ditches, from yards, and other sources.

Second is a similar problem in Dry Creek, a tributary to Jewett Creek. Urban runoff from stormwater and bank erosion contributes to sediment and turbidity in lower Jewett Creek, especially during flood events.

The third source for sediment input into the system is a result of winter road maintenance. Sand is spread on ice and snow to increase traction, and is later conveyed into the creek by the melting snow and by subsequent rains.

An occasional excess of chlorine has been noted in Spring Creek, a tributary of Jewett Creek which enters at Jewett stream mile 1.5. During strom events, excess treated drinking water from the city of White salmon is occasionally dumped into the creek.

Major Creek. Major Creek enters the Columbia River at river mile 177.2. Anadromous fish may be negatively affected by low summer flows from late July until the beginning of the fall rains. Causes of the low summer flows are not specifically known, but natural flow fluctuations and irrigation diversions in the upper watershed are suspected. Also, loss of groundwater storage due to agricultural practices in the upper watershed could be a contributing factor. Elevated temperature due to low flow may also be limiting.

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Appendix 1

WIND RIVER LIMITING FACTORS SCORING MATRIX

Stream	Site Problem	# Stocks Affected	Stock Status	Blockages Below	Stream Miles Affected	Contribute to CWA Standard Exceedences	# LFs	Severity of LF Impact	Relative Contribution of SP to LF	Critical Nature of Habitat (Bottleneck)
Youngman	Culvert	1	1ESA	0	0.75	N	1	L	H	L
	Riparian	2	1ESA	0	1.7	Y	5	M	L	M
Oldman	Culvert 1	1	1ESA	0	3	N	1	L	H	L
	Culvert 2	1	1ESA	1	2.25	N	1	L	H	L
	Culvert 3	1	1ESA	2	2	N	1	L	H	L
	Riparian	2	1ESA	0	2.1	Y	3	M	L	M
Paradise	Mass Wasting	2	1ESA	0	8	Y	1	M	L	M
Dry	Riparian	1	1ESA	0	4.4	Y	3	L	H	L
	LWD Removal	1	1ESA	0	4.4	Y	2	L	H	L
Wind	Diking/Road	2	1ESA	0	4	N	1	M	H	M
	Riparian	2	1ESA	0	8	Y	2	M	H	M
Trapper	Channelization	2	1ESA	0	1	N	1	M	H	M
	Floodplain Filling	2	1ESA	0	1	N	1	M	H	M
	Diking	2	1ESA	0	1	N	1	M	M	M
	Chnl Downcutting	2	1ESA	0	1	N	1	M	M	M
	Chnl Constriction	2	1ESA	0	1	N	1	M	H	M
Wind	LWD Removal	2	1ESA	0	8	Y	1	M	H	M
	Riparian	2	1ESA	0	8	Y	1	M	H	M
	Floodplain Filling	2	1ESA	0	7	N	1	H	H	H
	Diversion	2	1ESA	0	1.5	Y	1	M	H	M
Tyee	Diversion	2	1ESA	0	1	N	1	M	H	M
Crater	Riparian	1	1ESA	0.5	0.75	Y	8	H	M	H
	LWD Removal	1	1ESA	0.5	1.5	Y	5	H	M	H
	Chnl Downcutting	1	1ESA	0.5	1.5	Y	3	H	M	H
Compass	Riparian	1	1ESA	0.5	1.7	Y	8	H	M	H
	LWD Removal	1	1ESA	0.5	1.7	Y	5	H	M	H
	Chnl Downcutting	1	1ESA	0.5	1.7	Y	3	H	M	H
Layout	Riparian	1	1ESA	0.5	2.3	Y	8	H	M	H
	LWD Removal	1	1ESA	0.5	2.3	Y	6	H	M	H
	Chnl Downcutting	1	1ESA	0.5	2.3	Y	6	H	M	H
Trout	Hemlock Dam	1	1ESA	0	50	Y	2	H	H	H
	Riparian	1	1ESA	0.5	7.6	Y	4	H	M	H
	LWD Removal	1	1ESA	0.5	7.6	Y	3	H	M	H
	Chnl Downcutting	1	1ESA	0.5	7.6	Y	3	H	M	H
Wind	Mass Wasting	3	2ESA	0	1.5	Y	1	L	H	L
Little Wind	Mass Wasting	2	2ESA	0	1.5	Y	1	L	H	L
	Wind	4	2ESA	0	1.5	Y	1	L	L	L

APPENDIX 2

IDENTIFIED LIMITING FACTORS FOR WRIA 29

Identified habitat limiting factors for WRIA 29

Stream Name	**WRIA INDEX**	Fish Passage	Floodplain Connectivity	Bank Stability	LWD	Pools	Side Channel Habitat	Substrate Fines	Substrate Coarse	Riparian	Water Quality	Water Quantity
Upper Wind River	29.0023		X			X	X				X	
Youngman	29.0121	X						X		X		
Oldman	29.0120	X				X						
Paradise	29.0112			X								
Dry	29.0098					X			X			X
Middle Wind	29.0023	X	X			X	X			X		X
Trapper	29.0097		X	X	X	X	X		X			
Tyee	29.0096	X										
Trout	29.0075	X	X	X	X	X	X	X		X	X	
Layout	29.0082		X	X	X	X	X	X		X	X	
Compass	29.0086		X	X	X	X	X	X		X	X	
Crater	29.0085		X	X	X	X	X	X		X	X	
Lower Wind	29.0023			X				X				
Little Wind	29.0024			X				X				
Foster	None	X										
Rock	29.0001								X		X	
Nelson	29.0019										X	
Carson	29.0022	X									X	X
Collins	29.0128	X										
Un-named (Grant Lak	29.0129							X				
Dog	29.0130											X
Little White Salmon	29.0131										X	
White Salmon	29.0160	X			X	X			X			X
Jewett	29.0342	X						X		X	X	
Dry	29.0343			X								
Spring	None										X	
Major	29.0348									X	X	X

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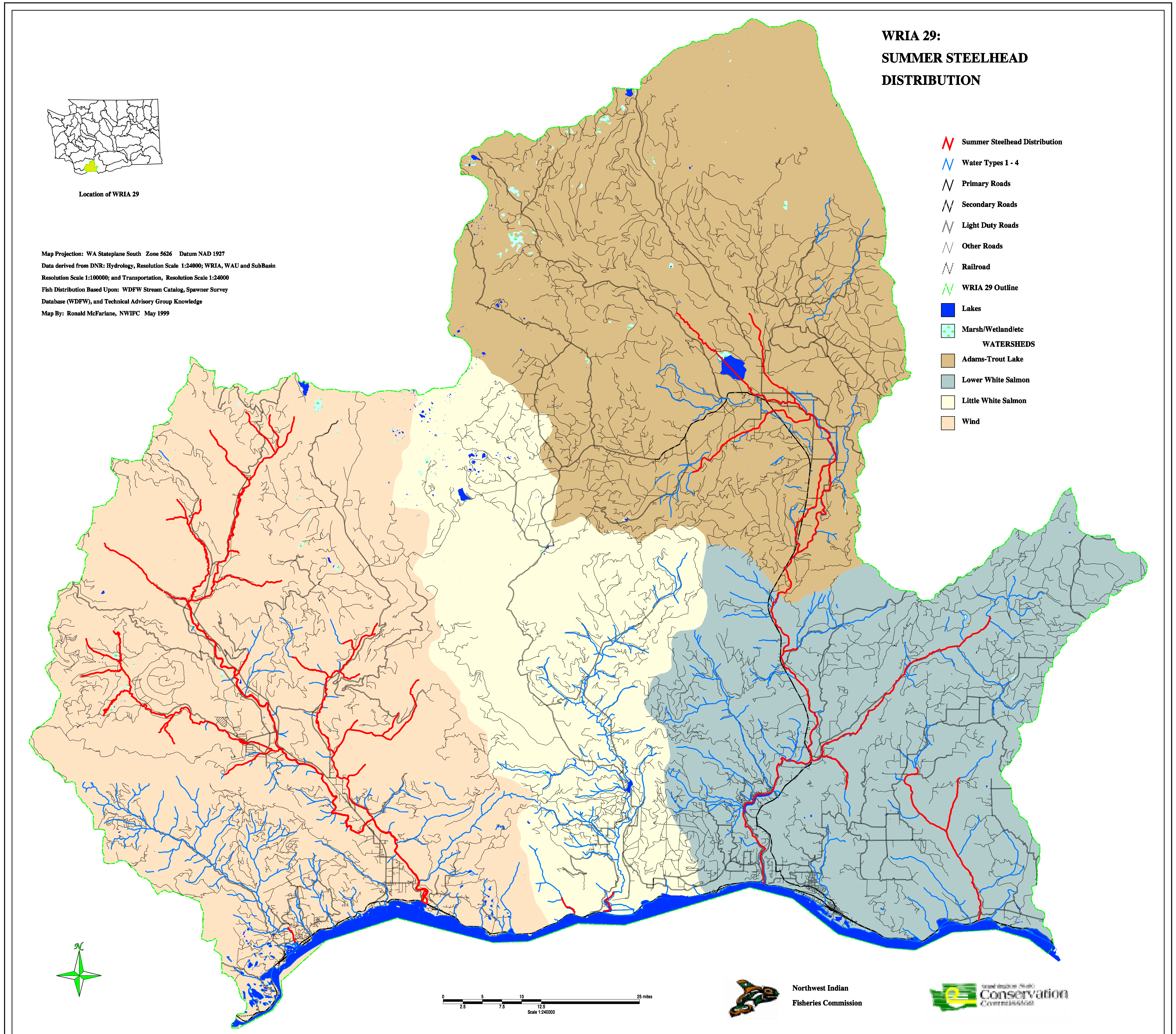
APPENDIX 3: FISH DISTRIBUTION IN WRIA 29 BY STOCK (INCLUDING POTENTIAL DISTRIBUTION ABOVE CONDIT DAM)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SUMMER STEELHEAD
DISTRIBUTION
Location of WRIA 29
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Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Summer Steelhead Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
WRIA 29 Outline
Lakes
Marsh/Wetland/etc
WATERSHEDS
Adams-Trout Lake
Lower White Salmon
Little White Salmon
Wind
N
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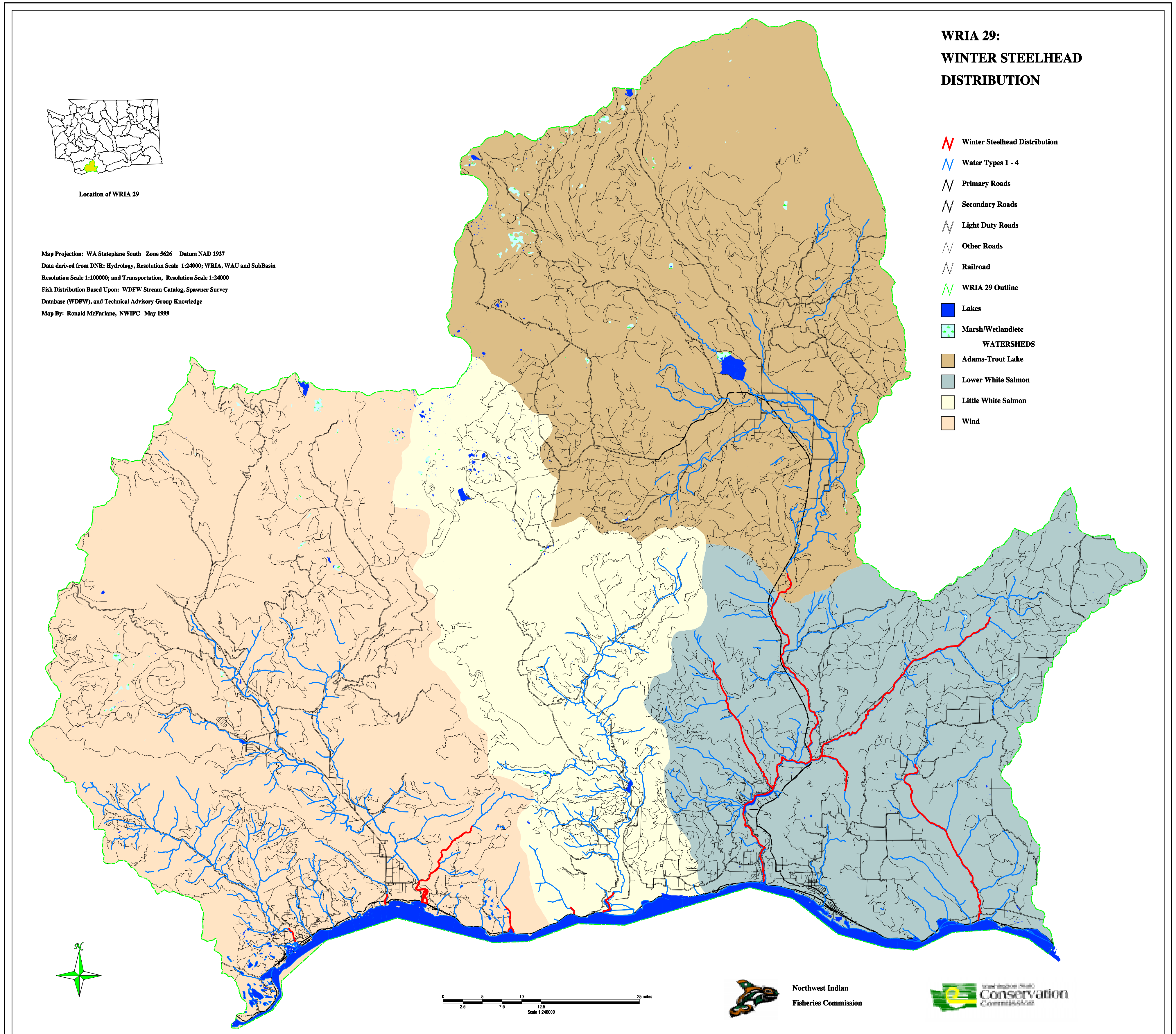
25 miles
2.5
7.5
12.5
Scale 1:240000
Northwest Indian
Fisheries Commission
Conservation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WINTER STEELHEAD
DISTRIBUTION
Location of WRIA 29
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Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Winter Steelhead Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
WRIA 29 Outline
Lakes
Marsh/Wetland/etc
WATERSHEDS
Adams-Trout Lake
Lower White Salmon
Little White Salmon
Wind
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25 miles
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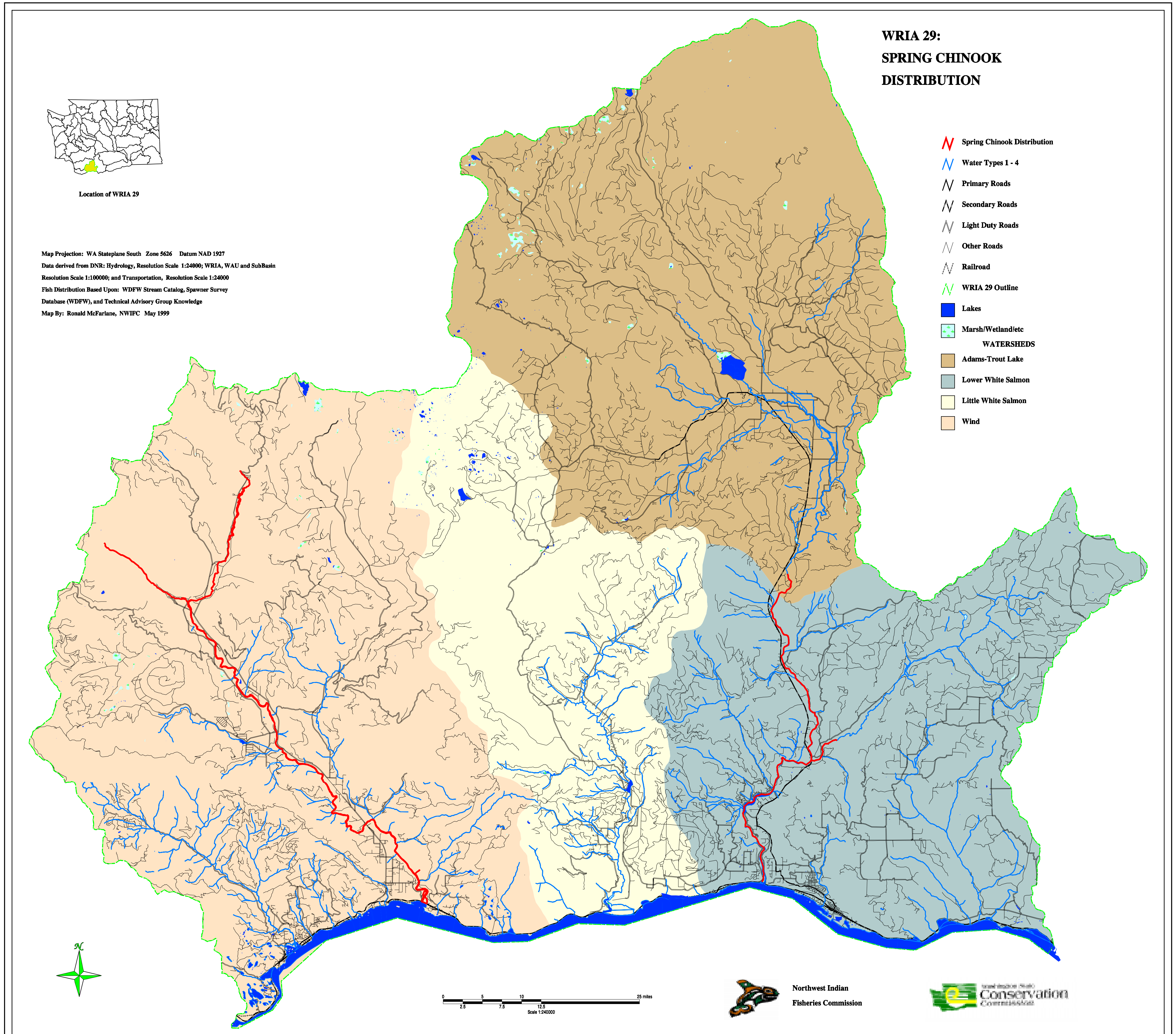
7.5
12.5
Scale 1:240000
Northwest Indian
Fisheries Commission
Conservation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SPRING CHINOOK
DISTRIBUTION
Location of WRIA 29
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Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Spring Chinook Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
WRIA 29 Outline
Lakes
Marsh/Wetland/etc
WATERSHEDS
Adams-Trout Lake
Lower White Salmon
Little White Salmon
Wind
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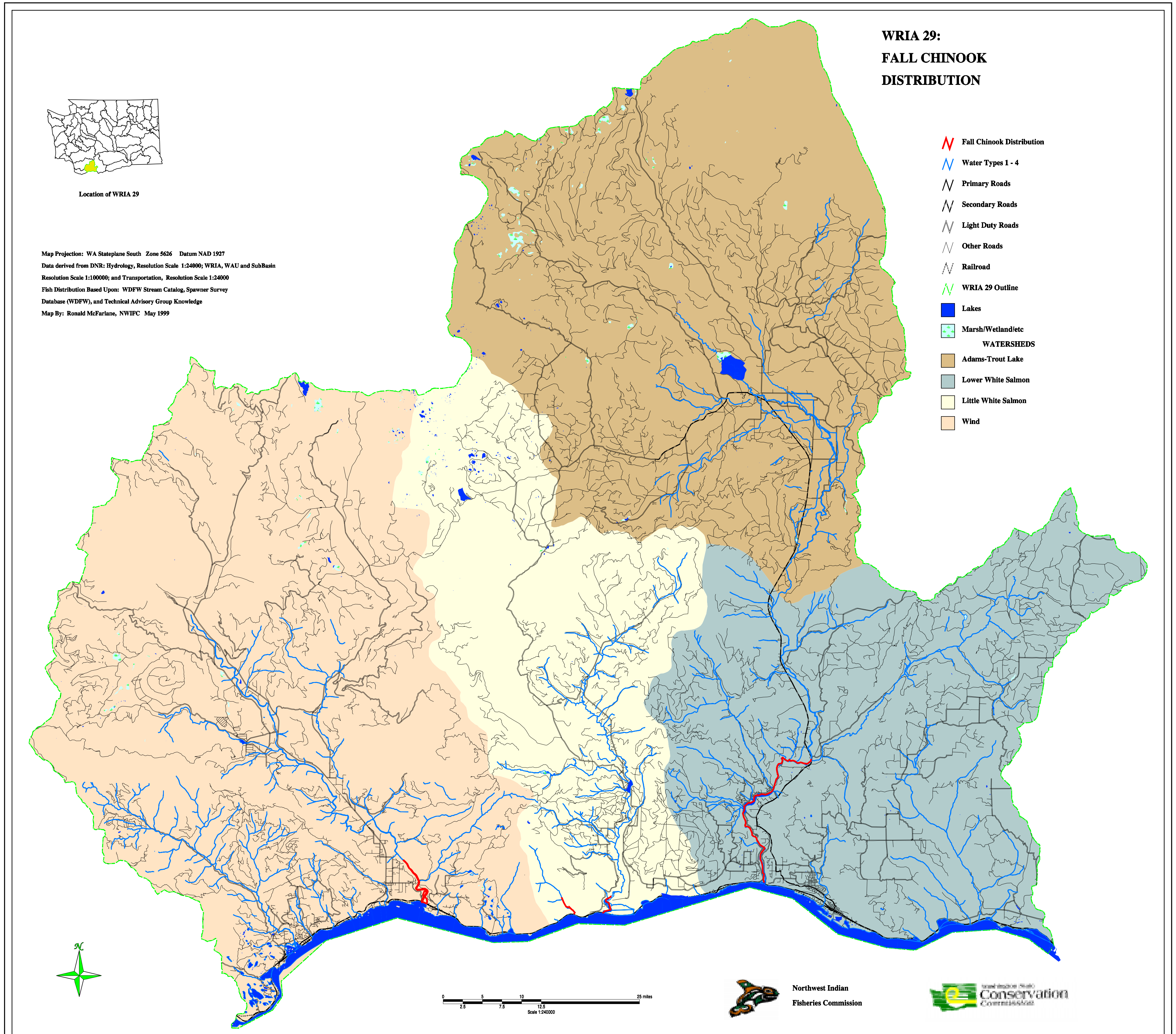
25 miles
2.5
7.5
12.5
Scale 1:240000
Northwest Indian
Fisheries Commission
Conservation
Commission


WRIA 29:
FALL CHINOOK
DISTRIBUTION
Fall Chinook Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
WRIA 29 Outline
Lakes
Marsh/Wetland/etc
WATERSHEDS
Adams-Trout Lake
Lower White Salmon
Little White Salmon
Wind
Location of WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
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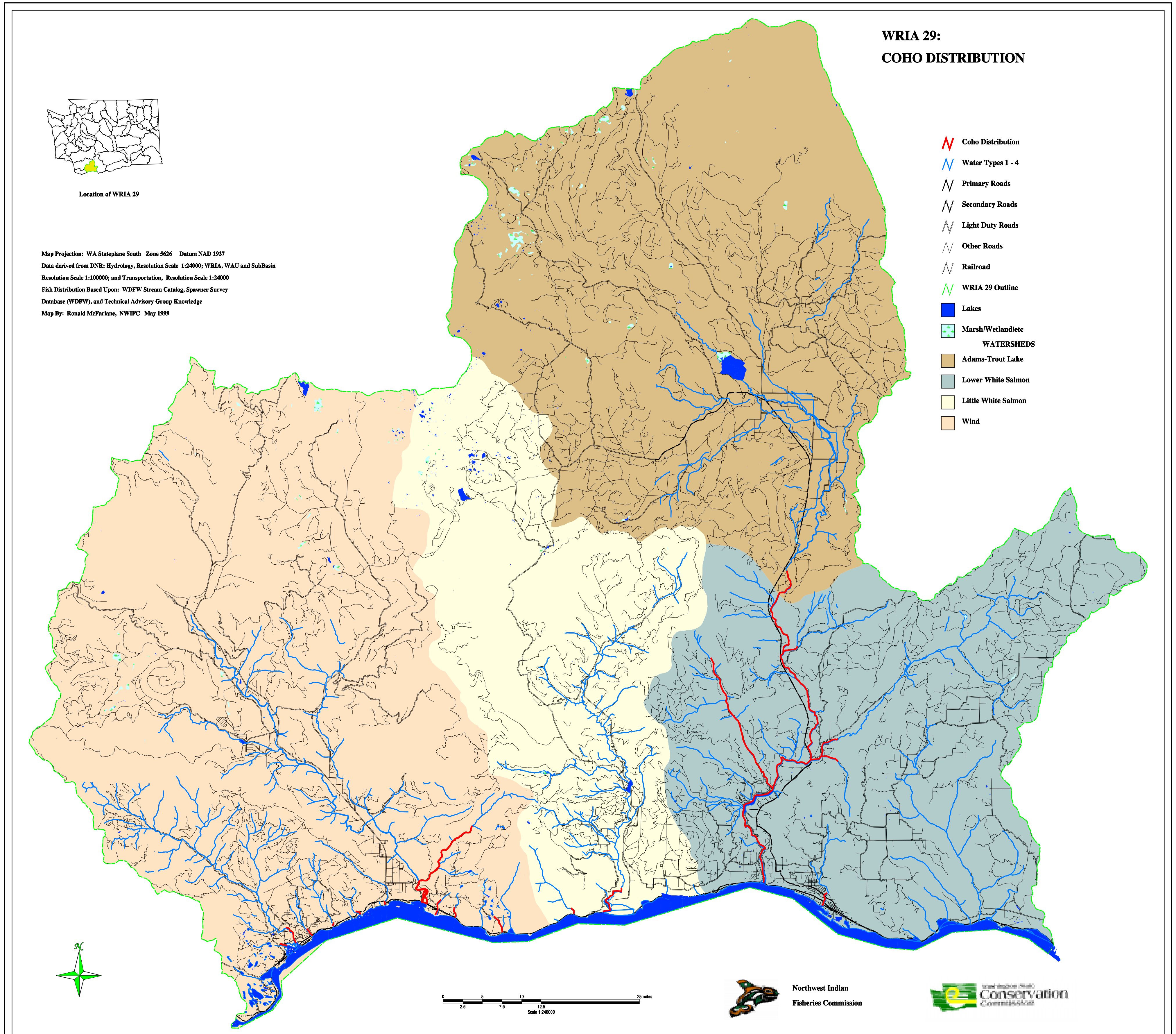
25 miles
2.5
7.5
12.5
Scale 1:240000
Northwest Indian
Fisheries Commission
Conservation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COHO DISTRIBUTION
Location of WRIA 29
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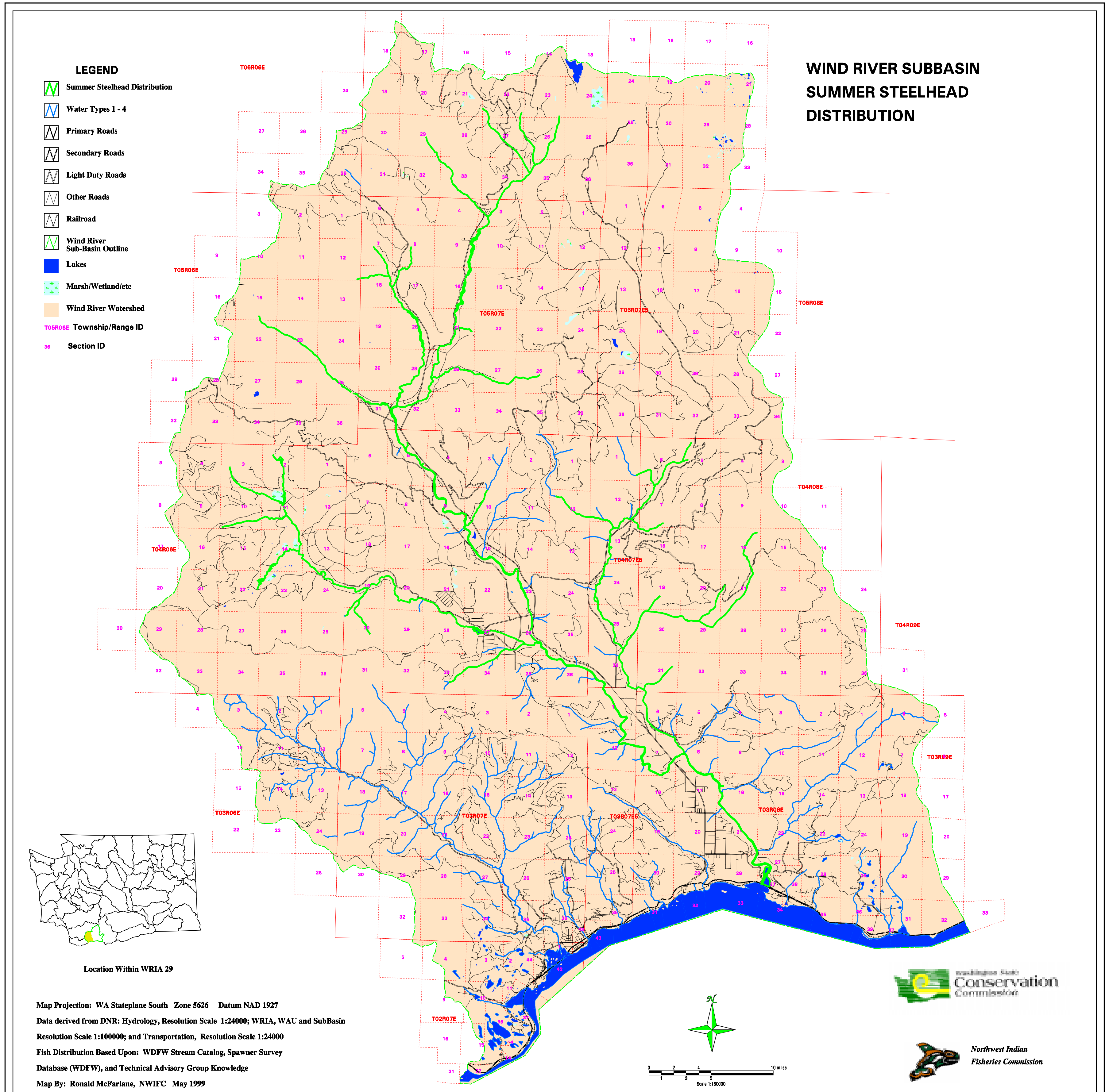
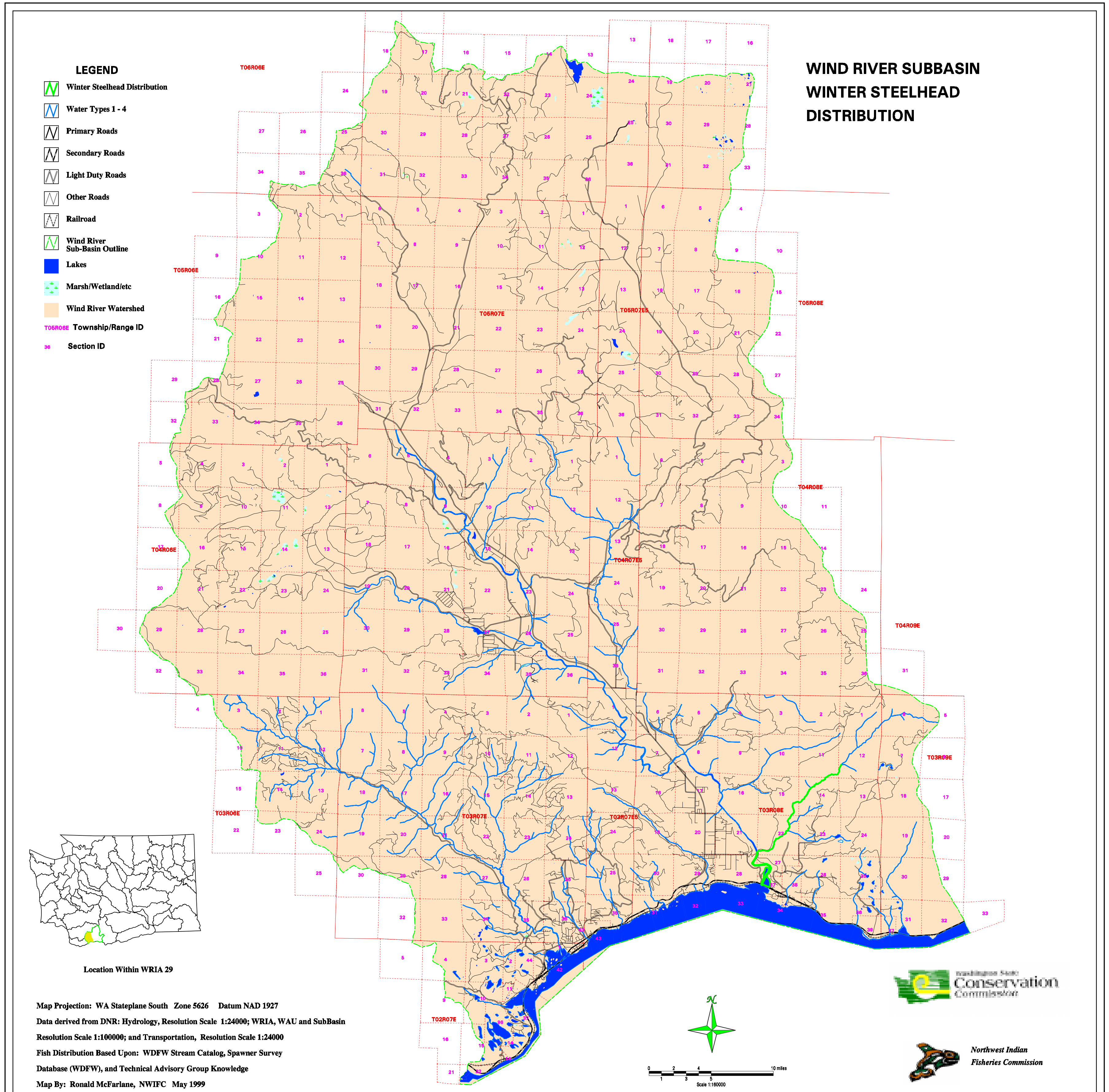
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Coho Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
WRIA 29 Outline
Lakes
Marsh/Wetland/etc
WATERSHEDS
Adams-Trout Lake
Lower White Salmon
Little White Salmon
Wind
N
Northwest Indian
Fisheries Commission
Conservation



WIND RIVER SUBBASIN
SUMMER STEELHEAD
DISTRIBUTION
LEGEND
Summer Steelhead Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Wind River Sub-Basin Outline
Lakes
Marsh/Wetland/etc
Wind River Watershed
Township/Range ID
Section ID
Location Within WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Northwest Indian
Fisheries Commission


WIND RIVER SUBBASIN
WINTER STEELHEAD
DISTRIBUTION
LEGEND
Winter Steelhead Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Wind River Sub-Basin Outline
Lakes
Marsh/Wetland/etc
Wind River Watershed
Township/Range ID
Section ID
Location Within WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
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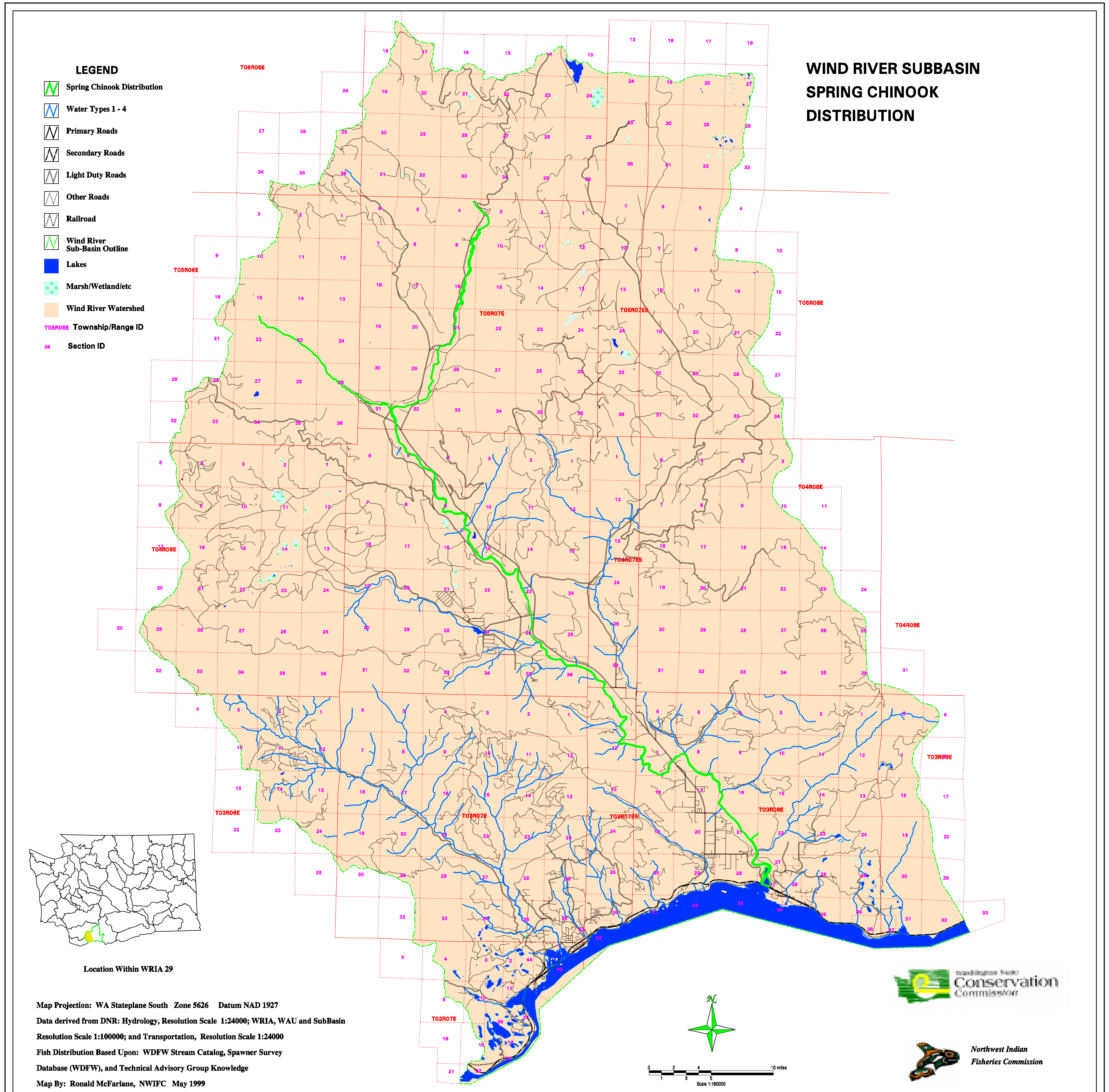
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Washington State Conservation Commission
Northwest Indian Fisheries Commission
10 miles


WIND RIVER SUBBASIN
SPRING CHINOOK
DISTRIBUTION
LEGEND
Spring Chinook Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Wind River Sub-Basin Outline
Lakes
Marsh/Wetland/etc
Wind River Watershed
Township/Range ID
Section ID
Location Within WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
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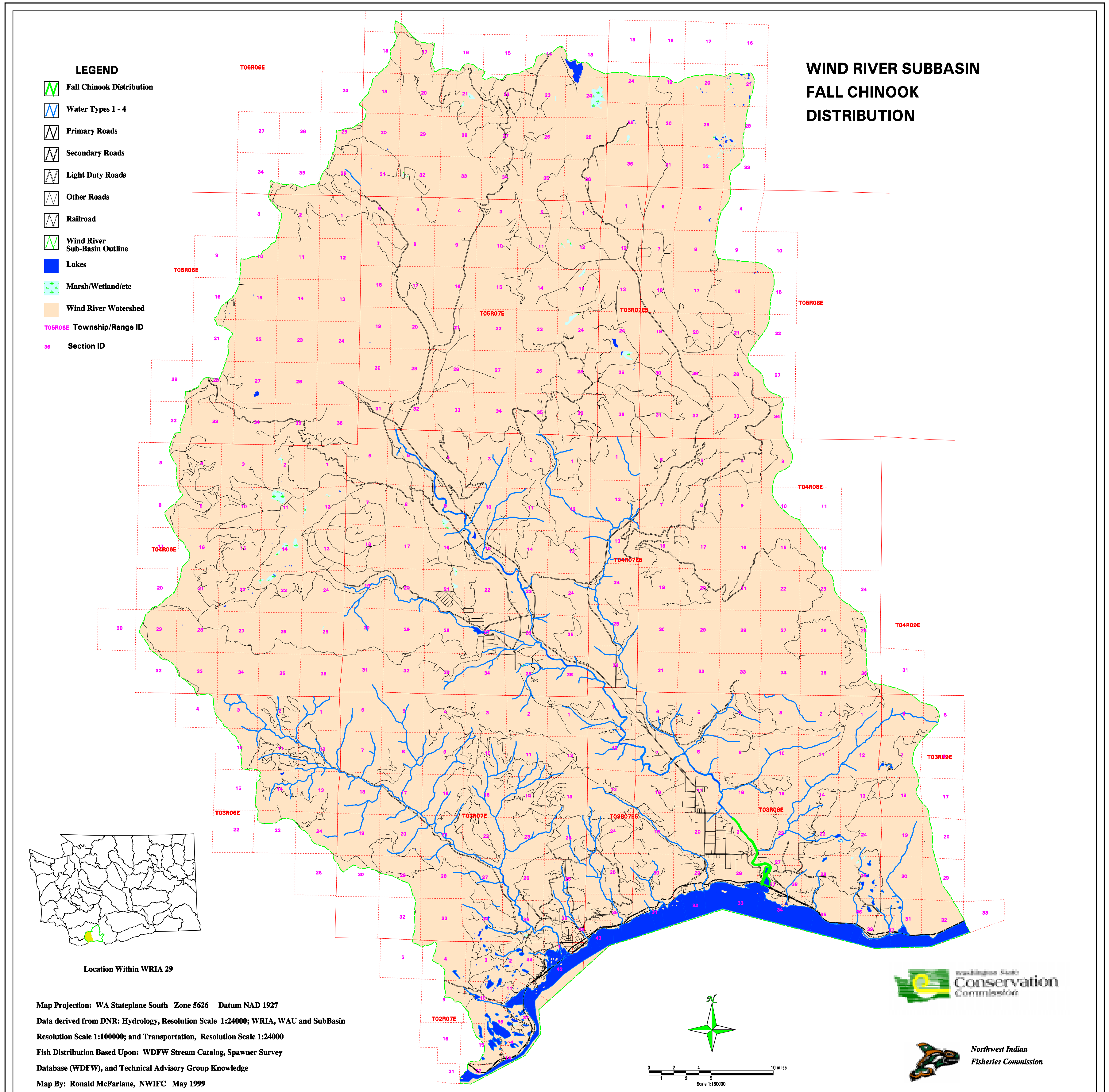
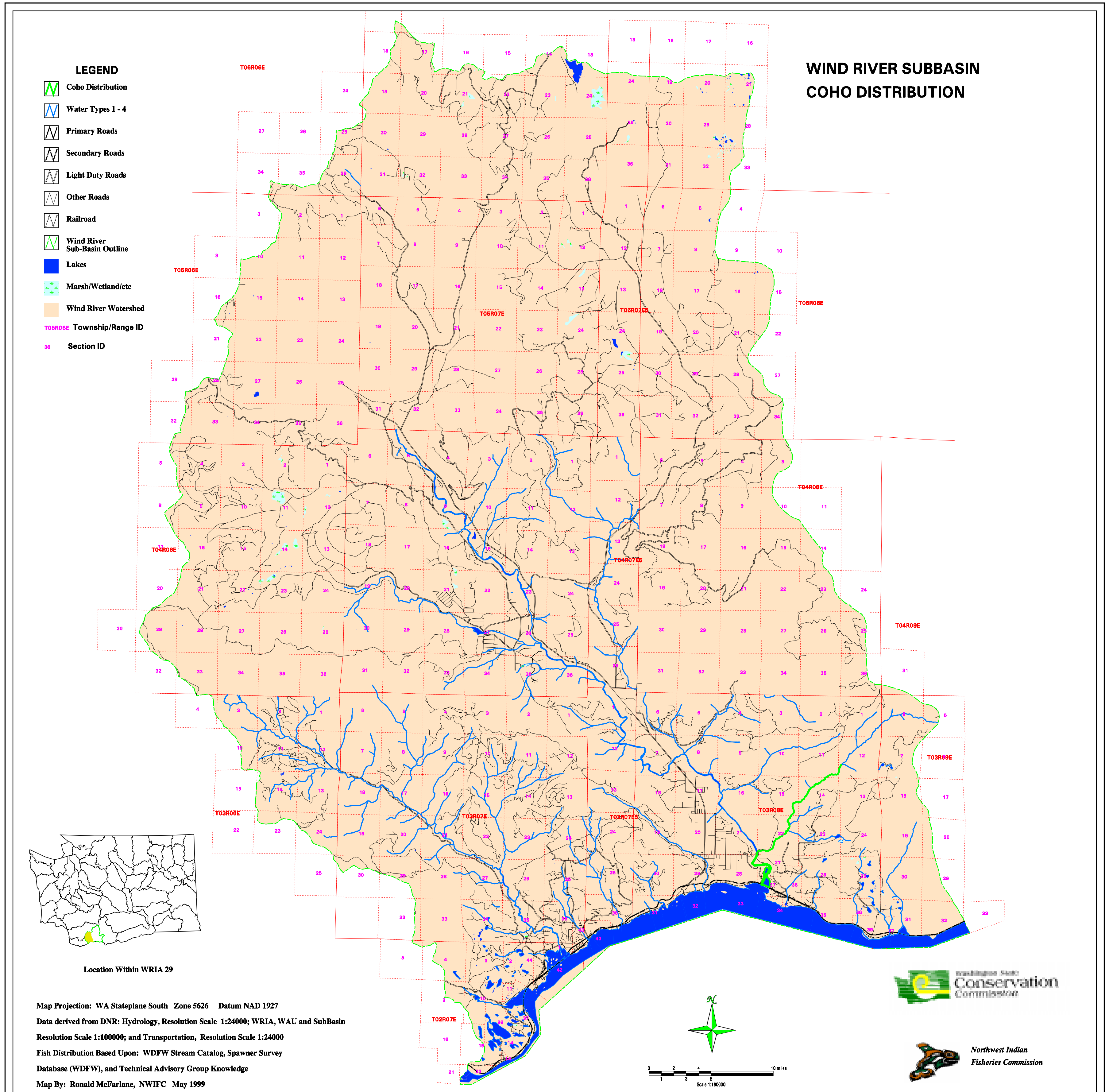
Fisheries Commission



WIND RIVER SUBBASIN
FALL CHINOOK
DISTRIBUTION
LEGEND
Fall Chinook Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Wind River Sub-Basin Outline
Lakes
Marsh/Wetland/etc
Wind River Watershed
Township/Range ID
Section ID
Location Within WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
Data derived from DNR: Hydrology, Resolution Scale 1:24000; WRIA, WAU and SubBasin
Resolution Scale 1:100000; and Transportation, Resolution Scale 1:24000
Fish Distribution Based Upon: WDFW Stream Catalog, Spawner Survey
Database (WDFW), and Technical Advisory Group Knowledge
Map By: Ronald McFarlane, NWIFC May 1999
Washington State Conservation Commission
Northwest Indian Fisheries Commission
10 miles


WIND RIVER SUBBASIN
COHO DISTRIBUTION
LEGEND
Coho Distribution
Water Types 1 - 4
Primary Roads
Secondary Roads
Light Duty Roads
Other Roads
Railroad
Wind River Sub-Basin Outline
Lakes
Marsh/Wetland/etc
Wind River Watershed
Township/Range ID
Section ID
Location Within WRIA 29
Map Projection: WA Stateplane South Zone 5626 Datum NAD 1927
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